THE STUDY OF INCIDENCE OF HOLLOW VISCOUS INJURY IN PENETRATING ABDOMINAL INJURIES

DISSERTATION SUBMITTED FOR

M.S. DEGREE BRANCH I (GENERAL SURGERY)

MARCH – 2010

THE TAMILNADU

Dr.M.G.R. MEDICAL UNIVERSITY

CHENNAI - 600032

DEPARTMENT OF SURGERY
MADURAI MEDICAL COLLEGE
MADURAI

CERTIFICATE

This is to certify that this dissertation entitled "**THE STUDY OF INCIDENCE OF HOLLOW VISCOUS INJURY IN PENETRATING ABDOMINAL INJURIES**" has been done by **Dr. KAREPAGOL BASAVARAJ** under my guidance in the department of surgery, Madurai Medical College, Madurai.

I certify regarding the authenticity of the work done to prepare this dissertation.

Dr.M.GOPINATH, M.S.,
Professor & HOD
Department of Surgery,
Govt. Rajaji Hospital
Madurai Medical College,
Madurai

DECLARATION

I**, Dr. KAREPAGOL BASAVARAJ** solemnly declare that the dissertation titled "**THE STUDY OF INCIDENCE OF HOLLOW VISCOUS INJURY IN PENETRATING ABDOMINAL INJURIES"** has been prepared by me.

This is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfillment of the requirement for the award of M.S.Degree in General Surgery , Examination to be held in March 2010.

Place : Madurai

Date :

Dr. KAREPAGOL BASAVARAJ

ACKNOWLEDGEMENT

It gives me great pleasure to acknowledge all those who guided, encouraged and supported me in the successful completion of my study.

I express my gratitude to the dean in charge, **Dr. S.M.Sivakumar, M.S** for allowing me to utilize the clinical materials for this study.

Foremost, I wish to express my sincere gratitude to **Prof. Dr. M.Gobinath M.S.,** head of the department, department of surgery, Govt. Rajaji hospital, Madurai medical college for his valuable support and guidance in completing this study.

My sincere thanks to **Prof. Dr. D.Soundararajan M.S.,** my unit chief for his valuable guidance and motivation to complete this study.

I wish to thank my unit Assistants Professors **Dr. S.P.Ramanathan M.S, DNB., Dr. V.Selvaraj M.S., Dr. K.Saravanan M.S., Dr. Shanthi Nirmala M.S, DGO.,** for there valuable guidance and support.

I sincerely thank my seniors, colleagues and friends for their support and guidance.

I owe my sincere thanks to all the patients who have cooperated in rendering themselves for the study.

CONTENTS

INTRODUCTION

Trauma ranks along with cardiovascular and malignancy as a major cause of morbidity and mortality. Still trauma continues to be a leading cause of death in the first four decades of life. There are various predisposing factors of trauma like high speed vehicles, stab injuries, terrorism. Major trauma does not respect and restrict itself to one organ or one system. Evaluation of patient with abdominal trauma can be most challenging task that a surgeon to be called upon to deal with. Penetrating abdominal injuries may be parietal or visceral or perforating through and through injuries. Visceral injuries may be intraperitoneal or retroperitoneal. Stomach, duodenum, small bowel, large bowel are the organs included in the study. Multiorgan injuries, exsanguinated hemorrhages, delayed presentations and the ominous reputation for high mortality and morbidity are just few of the many reasons which make this topic of penetrating injuries a fascinating one.

AIM OF THE STUDY

1. The study was aimed at the incident of injury to the stomach, small bowel, large bowel, in different types of penetrating abdominal injuries.

This study also aimed at,

2. Mode of injury
3. Clinical presentation
4. Management
5. Prognosis

SURGICAL ANATOMY

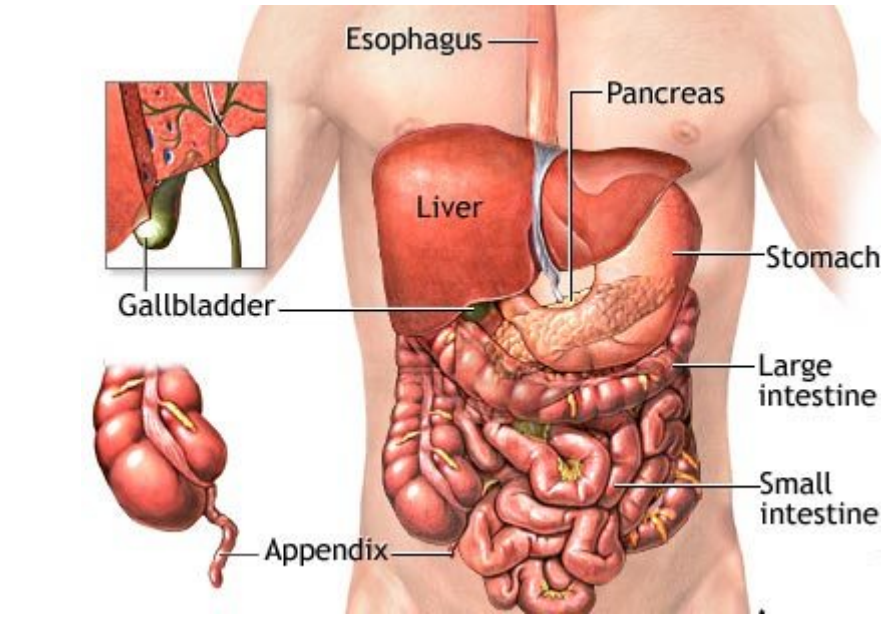
A review of the surgical anatomy of the abdominal organs is necessary at this juncture to appreciate the various aspects of penetrating abdominal injuries.

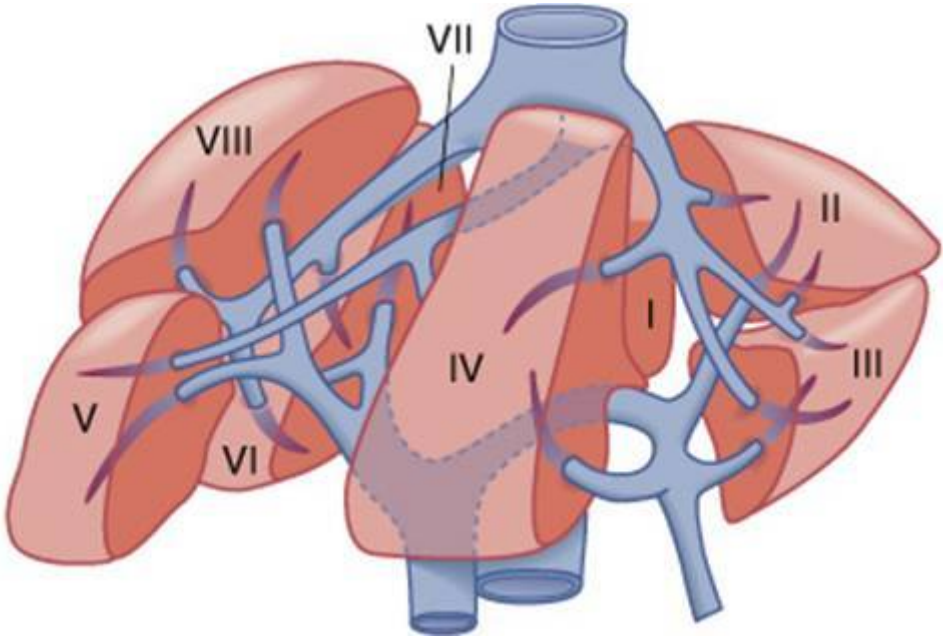
Liver

The liver is the largest gland in the body, weighs about 1500 grams, developed from ventral mesogastrium. It is situated under diaphragm more on right side extending to the left. Liver has to surfaces diaphragmatic and visceral surfaces. Liver is held in position by attachment IVC and hepatic veins. Surgically divided into right and left lobe by a principle plane which passes from medial aspect of gall bladder to IVC posteriorly. The French segmental system divides liver into eight lobes according to C. Blood supply is by hepatic artery and portal vein supplying 25% and 75% of total blood supply, by supplying 50% of oxygen each. Drained by right, middle and left hepatic veins and also about 10-15 small veins drain directly into IVC. Bile ducts drain bile which is synthesized and excreted by liver.

The ligaments which are attached to the liver are right and left triangular ligaments, coronary ligament and lesser omentum. Hepatic artery, common bile duct and portal vein passes through the free border of lesser omentum. Pringle's maneuver is the temporary application of vascular clamp to the free margin of lesser omentum upto a period of 20 minutes to 1 hour, indicated in major bleeding from hepatic or perihepatic injury so that bleeding points can be arrested by

topical cooling. Inj methyl prednisolone 30-40 mg/kg IV have been found to protect the hepatocytes during clamping.





Spleen

Spleen is the largest lymphoid organ in the body developed from dorsal mesogastrium. It lies under diaphragm on the left side of the abdomen closely in contact with 9th, 10th and 11th rib. It measures 1x3x5 inches, weighs 7oz. its long axis lie along the line of 10th rib. The spleen is the firm organ of dull red color, roughly the size and shape of clenched fist. Spleen is freely mobile organ and held in position by linorenal ligament and gastrosplenic ligament. Phrenicocolic ligament gives additional support. Spleen is supplied by splenic artery passes between the layers of linorenal ligament. At the hilum it breaks up into 4-5 branches which enter the hilum separately. Similar veins leave the hilum and unite to form the splenic vein. The hilum of spleen is closely related to the tail of pancreas, so concomitant pancreatic and splenic injuries are common.

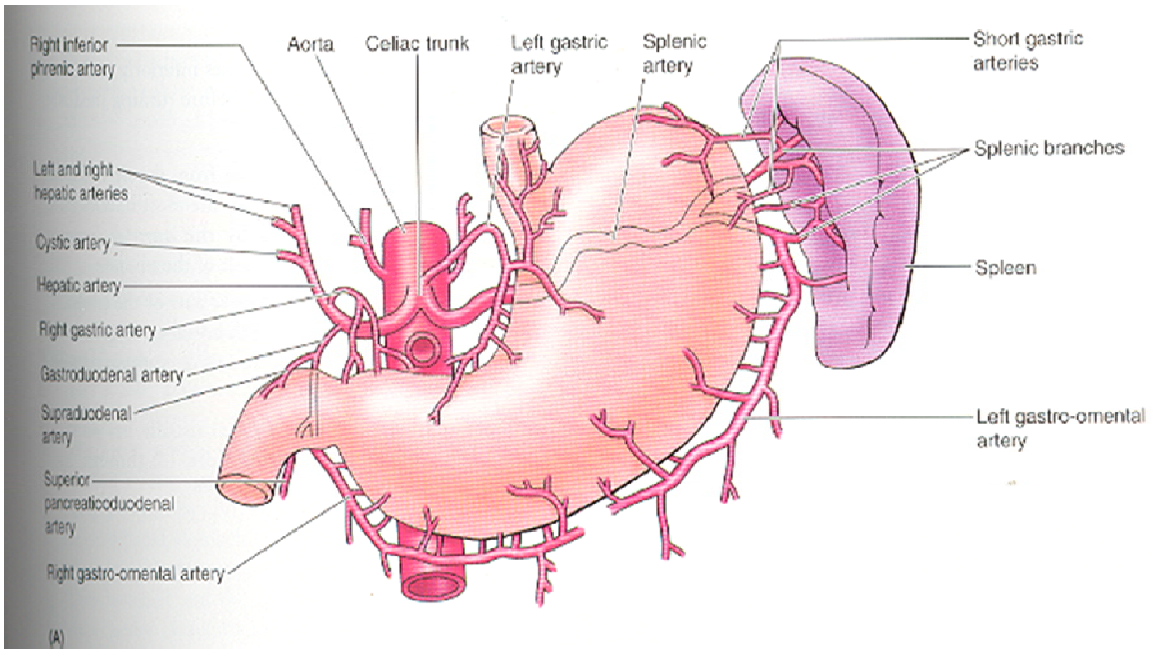
Spleen acts as immunological filter. It produces opsonin ‘tufstin’ – a tetrapeptide that coats white cells to promote phagocytosis of particular matter, bacteria and aged red cells. It is a source of properdin, a vital component of alternative pathway of complement activation.

Stomach

The stomach, located in the intrathoracic portion of the abdomen is well protected from injury by the overlying rib cage. It is loosely suspended in the abdomen by the gastrohepatic ligament superiorly, the gastrocolic ligament

interiorly and by its attachment to the spleen laterally. I addition to these attachments, it is relatively fixed at the gastroesophageal junction and the retroperitoneal duodenum. The gastric wail consists of an external serosal layer followed by three layers of smooth muscle — an outer longitudinal layer, middle circular layer and an inner oblique layer. A strong submucosal layer is followed by; a mucosal layer with a rich capillary network. This network is supplied by arterioles, which originate in the submucosa.

The stomach is supplied by four major nutrient arteries with extensive collateral circulation between the vascular beds. The left gastric artery most commonly arises from the celiac axis and usually splits into anterior and posterior trunks before it reaches the stomach. Branches from the left gastric artery supply the distal esophagus and the cardiac portion of the stomach. The right gastric artery most commonly originates from the common hepatic artery and it anastomoses with the left gastric circulation along the lesser curvature. The left gastroepiploic artery is collateral of the splenic artery and supplies the greater curvature. It anastomoses with right gastroepiploic artery in about 75% of cases. The more proximal portion of greater curvature is supplied by the short gastric vessels which originate from the gastroepiploic artery arises from the gastroduodenal artery and supplies the pyloric area and distal greater curvature. Venous drainage from the lesser curvature is via the coronary vein to the portal vein. On the greater curvature, drainage is via the short gastric vessels and right and left gastroepiploic veins to the splenic vein.

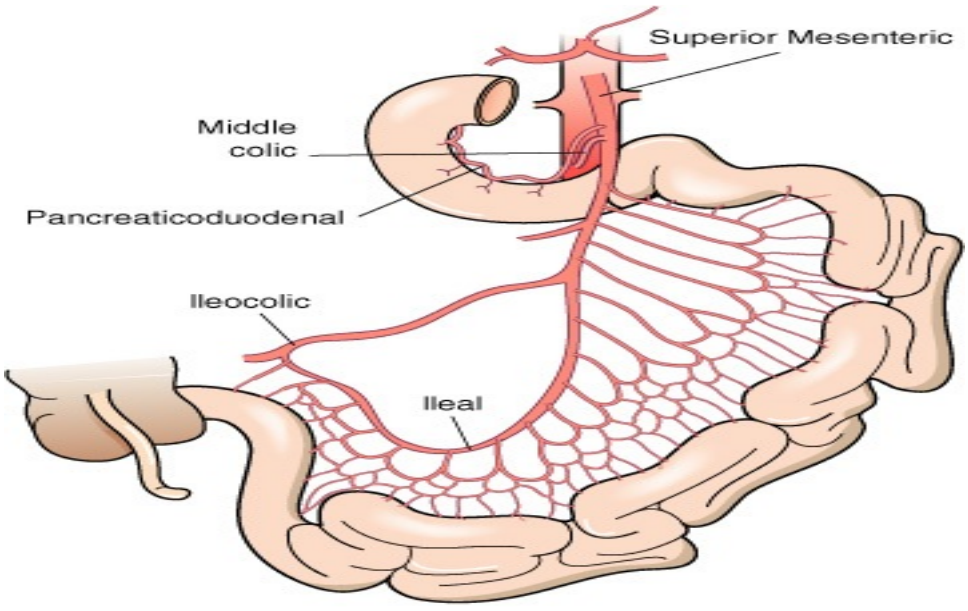


Duodenum

The duodenum extends from the pylorus, ties opposite to the right side of the spine at the level of the first lumbar vertebra to the duodenojejunal flexure. It is roughly c-shaped and about 25 cm long. It is an unique piece of small bowel because of its retroperitoneal fixation and connection to the secretory ducts of liver and pancreas. The blood supply is shared with the head of the pancreas. The first portion of the duodenum is intraperitoneal and somewhat mobile. The remainder of the duodenum is retroperitoneal owing to the fusion of the posterior peritoneum with the duodenum. The second and right half of the third portion of the duodenum may be easily mobilized through this bloodless fusion plane, a Kocher's maneuver. An additional point of fixation occurs at the ligament of Treitz.

Small bowel

The small bowel extends from the ligament of Treitz to the caecum and is freely moveable on its mesentery. The upper two fifths are about twice body height. The fan-shaped mesentery suspends the small bowel and extends from the left side of the second lumbar vertebra downward to the right sacroiliac joint, traversing the transverse colon, duodenum, aorta, inferior venacava, right gonadal vessels, and right ureter. The superior mesenteric artery supplies the jejunum and ileum, arising from the aorta approximately 2 cm below the celiac trunk. After crossing the uncinate process of the pancreas, it enters the root of mesentery, giving off branches to pancreas, right colic and numerous intestinal vessels before it terminates at the medial aspect of the caecum. Importantly there are no named vessels connecting the root of the mesentery and the retroperitoneum. This allows mobilization of the right colon and entire small bowel cephalad to the inferior aspect of the pancreas.



Pancreas

The pancreas lies transversely across the upper part of the posterior abdominal wall and is about 15-20 cm in length, 3.1 cm in width, and 1-1.5 cm in thickness and weighs about 80-90 grams. Posterior to the pancreas is the inferior vena cava, aorta, left kidney, both renal veins and the right renal artery. The pancreatic head lies within the concave sweep of the duodenum. The splenic artery runs along the upper border of the pancreas and the splenic vein runs behind, just superior to the lower edge. The superior mesenteric vein and artery lies just behind the neck of the pancreas and are also enclosed posteriorly by an extension of the head known as uncinate process. The uncinate process lies between the inferior venacava and the portal vein.

The main pancreatic duct of Wirsung usually traverses the entire length of the gland slightly above the line, halfway between the superior and inferior edges and normally ends by joining the common bile duct. The accessory duct of Santorini branches out from the pancreatic duct in the neck of the pancreas and empties into the duodenum about 2.5 cm above the duodenal papillae sometimes the anomalous common hepatic artery and right hepatic artery may pass posterior to the portal vein. Awareness of this anomaly is useful for dissection of the portal triad to minimize inadvertent injury.

Kidneys

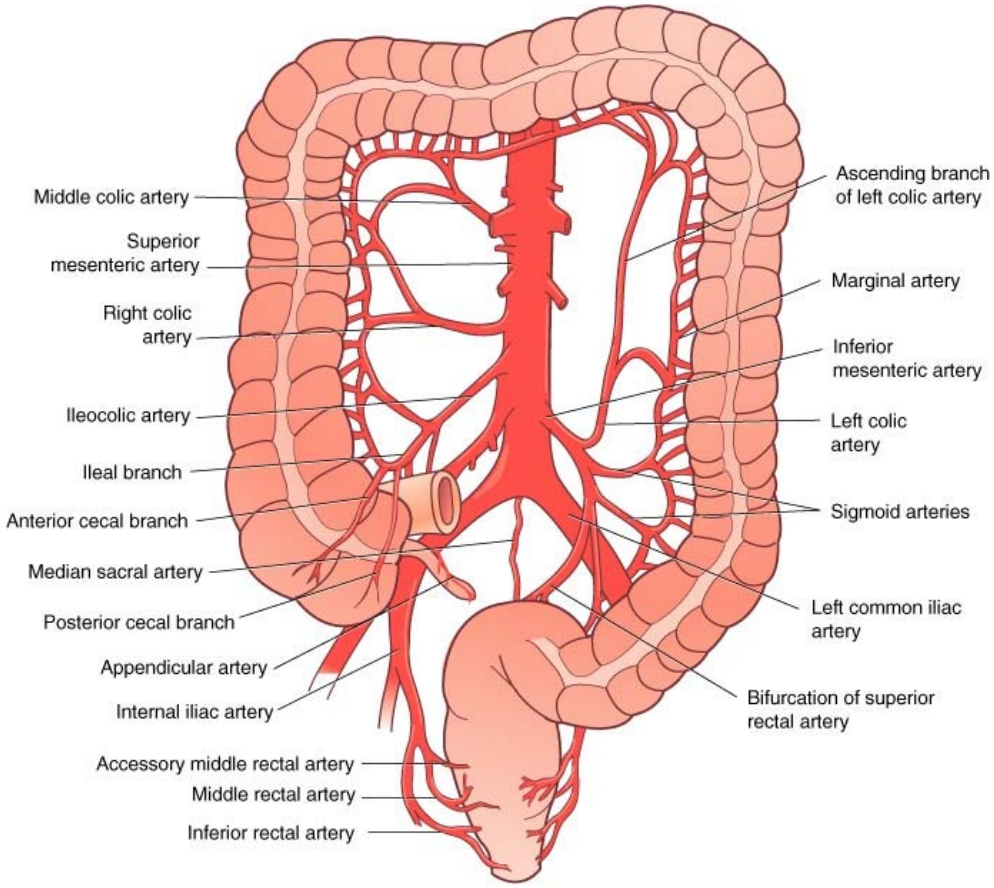
The kidneys lie high up on the posterior abdominal wall behind the peritoneum largely undercover of the costal margin. Each kidney lies obliquely, with its long axis parallel with the lateral border of psoas major. Normal kidney measures about 12x6x3 cm and weighs about 130 grams. The hilum of the right kidney lies just below and the hilum of the left just above the transpyloric plane, 5 cm from the midline. The relations of kidney-posteriorly mostly the diaphragm and the quadratus lumborum muscles which overlap medially on to psoas and laterally on to transverses abdominis. The right supra renal gland pyramidal in shape surmounts the upper pole of right kidney whereas the left suprarenal is cresentric in shape and is applied to the medial border above the hilum. The anterior relations of the right kidney are duodenum, hepatic flexure, coils of jejunum, liver, whereas the anterior relation of the left kidney includes the tail of the pancreas, splenic flexure, and stomach. The perinephric fat lies outside the renal capsule. The renal fascia surrounds the perinephric fat. At the hilum the vein, artery and the pelvis lies in the order from anterior to posterior. The constant anatomy of the origin of the renal arteries on both sides, which is posterior to the point at which two left renal veins, joins the inferior venacava. This is very important in controlling the renal pedicle initially before the Gerota’s facia is opened.

Ureter

The ureter is 25 cm long. The ureter passes down on the psoas major under cover of the peritoneum and crosses the genitofemoral nerve, being itself crossed superficially by the gonadal vessels. On the right the upper part is behind the duodenum, while lower down it is crossed by the root of the mesentery and by the right colic, ileocolic and superior mesenteric vessels. On the left it is lateral to the inferior mesenteric vessels and is crossed by the left colic vessels and the sigmoid mesocolon. The blood supply is endangered if the ureter is stripped of the surrounding tissues.

Colon

It was commonly believed that right sided injuries did well with primary repair, whereas left-sided injuries were best managed by colostomy. The right colon is derived from the midgut and is supplied by the superior mesenteric artery, whereas the left colon originates form the hindgut and is supplied by the inferior mesenteric vessels. The right colon has a thin wall and a large lumen. The left colon is thicker and more muscular and has a smaller lumen. The right colon absorbs and dehydrates the small bowel contents, whereas the left colon functions primarily for storage. Despite the fact that there are definite anatomical and physiological differences between the right and left colon, both should be treated similarly.



Retro Peritoneal vasculature

The intra-abdominal retroperitoneal area contains numerous vascular structures. The abdominal aorta, inferior venacava, hepatic veins, iliac arteries, renal arteries, first portion of celiac axis, superior mesenteric artery, splenic artery, inferior mesenteric vein and the ascending lumbar vein are the vascular structures of interest to the surgeons, treating victims of trauma.

Having discussed the anatomy of various abdominal organs, it is important to discuss about the clinicopathological aspects and management of penetrating abdominal organs in general, recommended by various publications.

PATHO PHYSIOLOGY AND MANAGEMENT

Liver Injuries

Liver is largest organ in the abdominal cavity commonly damaged by in blunt and penetrating abdominal trauma and in thoraco abdominal injuries Because of its size, injuries sufficient to lacerate liver are associated with injuries to other organs in about 80% cases. 85% of liver injuries are not bleeding at the time of laparotomy and patient tolerates these injuries very well. Most liver injuries will intact require only documentation and no drainage. The minority of liver injuries therefore require definitive surgical care. The history of injury is helpful in that particularly any penetrating injury to the right rib cage or upper abdomen and a patient, who has a history of being in shock at the scene following blunt trauma abdomen should be suspected of having a major liver injury.

Grading of hepatic injuries (SCNA Vol.75 No.2 April 1995) [25]

	Grade	:	Injury Description. (1994 Revision)
I.	Haematoma	:	Subcapsular, <10% surface area
	Laceration	:	Capsular tear, <1 cm deep
II.	Haematoma	:	Subcapsular, 10-50% surface area Intraparenchymal, <10 cm Capsular tear
	Laceration	:	<3cm Parenchymal depth, <10cm in length

III	Haematoma	:	Subcapsular, >50% surface area or Expanding or ruptured subcapsular haematoma, (or) intraparenchymal haematoma.
	Laceration	:	> 3 cm parenchymal depth.
IV	Laceration	:	Parenchymal disruption involving 25 – 75% of hepatic lobe or 1-3 Couinaud's segments within a single lobe.
V	Laceration	:	Parenchymal disruption involving > 75% of hepatic lobe (or) > 3 Couinaud's segments within a single lobe.
	Vascular	:	Juxtahepatic venous injuries.
VI	Vascular	:	Hepatic avulsion

- **Advance one grade for multiple injuries upto grade III**

After resuscitation the patient plain X ray abdomen should be taken and shows altered liver border, haemoperitoneum and associated rib fractures. Abdominal paracentesis is positive, if large amount of blood presents in the peritoneal cavity. DPL is diagnostic of minimal haemoperitoneum, but not specific for liver injury, CT is the investigation of choice in multiply injured patients provided patient is haemodynamically stable. Radionuclide scan are rarely done to document location of biliary fistula after repair of hepatic injuries.

Treatment [23]

I. Non-operative management

Indicated in

(1) Simple hepatic parenchymal laceration or intrahepatic haematoma.

(2) No evidence of active bleeding

(3) Intraperitoneal blood toss <250 ml

(4) Absence of other intra-abdominal & injuries patients should be followed with CT scan.

During observation, if the patient shows any signs of bleeding, arteriography and therapeutic embolisation can be done.

Indications for laparotomy during observations are:

(1) Continuing need for blood transfusion, increasing (or) deteriorating vital signs.

(2) Peritoneal signs

(3) Progressive expansion of haematoma

(4) Haematoma thought to represent a septic focus

Operative Management

(**A) Simple Techniques of Repair:**

(1) Drainage of non bleeding injuries rarely performed nowadays.

(2) Compression: Small cracks in the capsule can be treated by compression for 5 to 10 minutes to stop bleeding.

(3) Topical agents: The application of surgical or Fibrin glue or Avitene is use for when avulsion of Glisson's capsule is present. After application of topical agent to the raw hepatic surface, 5 minutes of compression with pads is applied. After removal, eletrocautry can be used for any bleeders.

(4) Suture hepatorrhaphy: Horizontal mattress sutures with 110 chromic catgut (or) simple continuous suturing with 1/0 chromic catgut can be done, with these measures most of the bleeding stops.

(B) Advanced Techniques of Repair:

(1) Extensive Hepatorrhaphy:

If simple suturing fails to stop, multiple horizontal mattress sutures are made in the parenchyma, but bleeding from intralobar branches of hepatic artery, portal vein (or) hepatic vein are not controlled by this method.

(2) Hepatotomy with selective vascular ligation:

It is indicated when bleeding vessels present deeply. Hepatotomy is done with finger fracture technique. Bleeding vessels and biliary radicals are identified and ligated.

(3) Omental Pack:

In 1975 Stone and lamb first described the use of a viable pedicle of omentum placed into deep lobar lacerations to control hemorrhage at the base. Pedicled omentum from transverse colon can be placed over liver laceration to

control bleeding, especially in bare area of liver. Omentum fills the defect and it is fixed with sutures.

(4 Debridement with selective vascular ligation:

It is indicated whenever there is loose friable and partially devascularised hepatic tissue on the edge of liver or in a hepatic laceration or missile tract. It is used in preference to anatomic segmentectomy or lobectomy, as these techniques frequently sacrifice large amounts of normal hepatic tissue.

(5) Resection:

It is indicated in the case of total disruption of lobe or segment, in the form of lobectomy or segmentectomy for that, knowledge of the anatomy is imperative.

(6) Selective hepatic artery ligation:

When selective vascular ligation fails, ligation of hepatic artery is an alternative. It may produce dramatic haemostasis without subsequent liver failure, but this should be done as close to liver as possible and only as a last resort.

(7) Pen hepatic packing:

This technique involves the insertion of laparotomy pads or rolls of gauze around the injured Liver not into hepatic lacerations. It is indicated in the following situations.

(a) Lack of facilities, blood or experience in dealing with hepatic trauma.

(b) Transfusion induced coagulopathy.

(c) Continued bleeding after performance of routine measures.

(d) Bilobar injury.

(e) Subcapsular hematoma.

(f) Profound hypothermia with hemodynamic or cardiac instability.

Packs can be removed 12 hours after packing.

Rebleeding and sepsis are common complications.

(8) Drainage:

Open Penrose drainage has been used after operative treatment, but incidence of intra abdominal sepsis is common.

(9) Gel foam pack & minsed fibers of rectus muscles may be used as pack.

(10) Hydrogen peroxide application will control generalized oozing from superficial hepatic abrasions.

Current Approach to hepatic injuries (Maingot's abdominal operations tenth edition)

- Extension of Pringle times (> 60 minutes) — Even after effective pringle's maneuver, if the bleeding continues from liver injury, it comes from hepatic vein injury.
- Hepatotomy with selective vascular ligation in preference to crushing mattress sutures.
- Debridement in preference to major resection.
- Omental pack to deep cracks or hepatotomy sites.
- Perihepatic pad packing for oozing from coagulopathies - 95%.
- Closed suction drains ……. alone?

Complications:

Significant complications following liver injury include,

1) Pulmonary complications

2) Coagulopathy

3) Hypoglycemia

4) Jaundice

5) Biliary fistulas

6) Haemobilia

7) Subdiaphragmatic and intraparenchymal abscess formation.

Splenic Injuries

The spleen is the intra-abdominal organ most frequently injured in blunt trauma. In penetrating trauma wound of entry or exit in the left chest, flank or left upper abdomen should arouse suspicion of splenic injury. The clinical picture of splenic injury includes left upper quadrant abdominal pain, signs of blood loss and pain in the left shoulder (Kehr's sign)

Grading of splenic injury (Shacford)

(Surgical clinics of North America Vol – 75, No: 2 April 1995)

Grade	Type	Injury description
I.	Haematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear, <1 cm parenchymal depth
II	Haematoma	Subcapsular, 10-50% surface area Intraparenchymal, <5 cm in diameter.
	Laceration	Capsular tear, 1-3 cm parenchymal depth In which does not involve a trabecular vessel.
III.	Haematoma	Subcapsular, >50% surface area or expanding; ruptured Subcapsular or parenchymal haematoma; intraparenchymal haematoma >5cm or expanding
	Laceration	> 3cm parenchymal depth or involving trabecular vessels.
IV	Laceration	Laceration involving segmental or hilar vessel producing major devascularization (>25% of Spleen)
V	Laceration	Completely shattered spleen
	Vascular	Hilar vascular injury which devascularizes spleen

- **Advance one grade for multiple injuries up to grade III**

Management

The management of splenic injury has been subject of major re-examination over the past decade and the recognition of fatal pneumococcal septicemia in patients undergoing splenectomy has led to an interest in splenic salvage. (D.B. Hyot and AR. Moossa et al)

Plain abdominal films may show:

1. Enlargement of splenic shadow
2. Elevation of left hemidiaphragm
3. Medial displacement of splenic shadow or stomach
4. Widening of the space between the splenic flexure and peritoneal pad. Peritoneal lavage should be performed when there is possibility of splenic injury, positive indicates laparotomy.

Ultrasound, CT Scanning and Radionuclide scanning can reveal significant splenic injury but should only be pursued with an understanding of what therapeutic plan will follow if these tests are positive[31].

The non operative approach to the splenic injury and spleen conserving surgery has been practiced now in major trauma centers with help of CT and radionuclide scan.

I. Non operative management:

Criteria for non operative management of splenic injury[4] :

a) Blunt trauma

b) An isolated splenic injury

c) If the patient presents more than 12 hours after injury or haemodynamically stable with no other signs of abdominal injury.

d) Patient should be fully alert (No head Injury or Intoxication)

The risk of non-operative management is missed injury to other viscera and delayed rupture of subcapsular haematoma. During observation patient should be followed sequentially with CT scan.

II. Spleen conserving surgery: [4,19] — **SPLENORRAPHY**

Contra Indications:

During the course of laparotomy the spleen is evaluated for hemorrhage Splenorraphy is not attempted.

(1) If it is a multiple injury case.

(2) Patient is in shock (systolic pressure less than 90 mm) (or)

(3) There are medical contraindications to prolonged surgery (bleeding disorder, cardiac, pulmonary (or) hepatic disease).

If the patient condition is favorable the decision to repair is based on the state of the spleen. Generally, grade IV and grade V injuries are not suitable for repair.

Indications:

Splenorraphy can be attempted in grade I, II and III.

Techniques of Splenorraphy: [4,19]

The following are the techniques for splenic repair

1) Local haemostatic agents - Gelatin foam, surgical cellulose, microfibrillar collagens, thrombin, cyanoacrylate, and autologous fibrin glue can be used for superficial tears which are not bleeding actively. But often pressure alone may be sufficient. Non bleeding tears are best left alone.

2) Suture repair: Deep parenchymal tears are managed by this technique. After removal of the clot and loose devitalized tissue, the wound is inspected. Arterial bleeders are controlled and the parenchyma is approximated using deep mattress sutures — vertical (or) horizontal including the fibrous capsule using absorbable sutures.

3) Partial splenectomy: Polar injury which is grade IV can be managed by segmental devascularisation and debridement by finger fracture technique at the line of demarcation. Additional security to the suture line after suture repair (or) partial splenectomy can be achieved by omental wrap. Buntain et al[4] have described an absorbable suture ladder to wrap the spleen.

4) Splenic artery ligation: It has also been described to achieve hemorrhage control. But it is not practiced frequently.

5) Heterotrophic autotransplantation of the splenic tissue : If the patient's condition permits, the splenic function can be preserved even after splenectomy by autotransplantation at sites like gastrocolic omentum, rectus sheath, anterior abdominal wall. Although splenic tissue has excellent ability to regenerate, the amount of splenic tissue remaining is important. To be effective in preserving

adequate splenic function, approximately one third of the original spleen must remain and be nourished by an adequate circulation. This is the procedure of choice especially in children.

Ill. Splenectomy:

Indicated in

1) Shattered or avulsed spleen

2) Severely hypotensive patients

3) Associated with other severe injuries

4) Undue delay in attempting to repair the spleen

Complications of splenectomy

1) Early transient thrombocytosis, which resolved spontaneously over 1-3months

2) Acute dilatation stomach

3) Delayed Hemorrhage

4) Pancreatitis

5) Subphrenic abscess

6) Left lower lobe atelectasis

7) Left pleural effusion

8) And fatal pneumococcal septicemia (over whelming post splenectomy syndrome OPSI) King H, Shumacker HB et al[19], Can be overcome by administering POLY VALENT ANTI PNEUMOCOCCAL VACCINE – once in 5 yrs given life long.

Gastric Injuries

Injuries of stomach are common in penetrating trauma but very rare in blunt trauma. The stomach is intrathoracic, partially protected by rib cage and any penetrating wound in this area should be suspected of causing injury to stomach. After resuscitation, a nasogastric tube is placed that serves both diagnostic and therapeutic functions. The return of gross blood on nasogastric aspirate is suggestive of an upper gastrointestinal injury. Haematemesis or bright red blood per nasogastric tube was present in 45% of gunshot wounds and 37% of stab wounds in series of patients with gastric injuries treated at Parkland memorial hospital[23]. The nasogasteric tube also serves a therapeutic function by decompressing the stomach.

Operative management

The intraoperative evaluation of stomach injury includes good visualization of the esophageal hiatus, evaluation of the anterior portion of the stomach, division of gastrocolic ligament and complete visualization of the posterior aspect of the stomach. Penetrating wounds are debrided and primary closure performed (Moossa AR. et al).[26] Despite the rich blood supply of the stomach, a few cases of gastric necrosis have been documented. Garfinkle reported one case of ischemic gastric necrosis along the greater curvature that he attributed to avulsion of the gastroepiploic vessels. Laceration of stomach may require gastric resection. Post

operative complications include intrabdominal abscess, particularly in the lesser-sac. Other complication is gastric fistula, needs immediate reoperation and repair.

Duodenal injuries

Penetrating injuries are the most common cause of duodenal injury. The penetrating injuries include gunshot (78%) stab wounds (16%) and shotgun wounds (6%) (SCNAVoI.70, no.3, June 1990)

Diagnosis of duodenal injuries

Serum amylase is sensitive but unfortunately not specific for duodenal injuries. Needle paracentesis or lavage will often be positive for blood, bile or bowel contents. But a negative duodenal lavage does not exclude all duodenal injuries[6]. The various radiological findings in duodenal injuries as described b Lucas.C.E[22] are

1) Intraperitoneal air

2) Retroperitoneal air

3) Air in the biliary tree

4) Scoliosis concavity to right and

5) Obliteration of psoas shadow.

The other investigations include water soluble contrast study alone or along with CT scan.

Treatment

Thal ER et al (1985)[17] have laid down the indications for exploration of the duodenum by kocherisation.

They include

I) Retroperitoneal hematoma in the right upper quadrant.

II) Crepitus or bile staining along the lateral wall of the duodenum.

III) Retroperitoneal edema.

IV) Petichae or fat necrosis in the retroperitoneum or right mesocolon

V) Retroperitoneal phlegmon and discoloration.

Duodenorrhaphy or simple repair will be successful in 70-85% of the wounds. A single layer closure can be used vertically to avoid tension and that too is in single layer because to avoid narrowing of the lumen. Various pyloro plasties might also be included in the management of proximal duodenal injuries (Maingot.R.Abdominal operations,)[23]. Tube duodenostomy, transnasal tube through the pylorus and retro grade sump tube through a witzel tunnel jejunostomy are the various means of achieving tube decompression of the duodenum.

The other methods used as complex repairs include[23,6]

a) Segmental resection and primary anastomosis

b) Serosal patch of jejunum (Kobold et al)

c) Roux en Y duodenojejunostomies (John.A.Kieigelt)

d) Diverticulisation procedure (Berne et al)[2]

e) pylorus exclusion (Vaughan.GD et al)

f) pancreatico duodenectomy(Snyder et al)[34]

g) triple tube drainage (Kelly et al, Stone et al)[18]

Pancreatic injuries

Pancreatic injuries still carry a combined morbidity and mortality rate in excess of 50% (Peitzman et al 1986)[31]. Fistula, pseudocyst, pancreatitis, anastomotic break down and intrabdominal abscess occur in 1/3d of the patients and account for the late mortality. Blaisdel fin et al states that currently 3-12% of all severe abdominal traumas include pancreatic injuries. Penetrating trauma accounts for approximately two thirds of these pancreatic injuries and blunt trauma for one third. 90% of the patients with pancreatic injuries have at least one associated injury with an average of 3.5 associated intrabdominal injuries per patient (Balasegaram.M 1979, [1] Graham. JM et al, 1978 and Stone HH et al 1981). The key determinant of outcome is the presence or absence of pancreatic duct injury (Gregory J. Jurkovich. MD).[17] the combined mortality from several large series of pancreatic trauma patients ranges from 10-25% and morbidity ranges from 30-40% (SCNA vol.70. No: 3 June 90).[17]

Diagnosis of Pancreatic Injuries

Epigastric pain out of proportion to the abdominal examination is often due to a retroperitoneal injury, the role of serum amylase in diagnosing pancreatic

injuries is controversial. Abdominal CT scan are currently reported as having a sensitivity and specificity in excess of 80% (Jefery KB et al, 1983).[16]

ERCP is the most useful in preoperative delineation of ductal anatomy in patients with delayed presentations or missed injuries (Whitwell et al, 1989).

The classification system and management of pancreatic injuries as outlined By Gregory J. Jurkovich[17] and C. James Carrico is as follows

Type 1: contusion and laceration without duct injury. This is treated by achieving hemostasis and external drainage.

Type 2: distal transaction or parenchymal injury with duct injury. This is managed by distal pancreatectomy.

Type 3: proximal transaction or parenchymal injury with probable duct injury treated by distal pancreatectomy or roux en Y, pancreaticojejunostomies.

Type 4: combined pancreatic and duodenal injury: ampulla and blood supply intact — repair and exclude duodenum and treat pancreas as per 1, 2&3. Massive injury and ampulla destroyed: devascularization -pancreaticoduodenectomy.

Small bowel injuries

Injuries to the small bowel are present in approximately 25-30% of the patients who require laparotomy after penetrating trauma, (Moossa AR. et al)[26]. Stab injuries are usually less severe than gunshot or blunt mechanisms of injury. In

most patients who sustain stab wounds the small bowel is spared because the mobility of small bowel afforded by the redundant mesentry, allows the intestine to slide away from an offending knife blade. (SCNA Vol 70 No: 3 June 90).[17]

Evaluation and Diagnosis

Although history and physical examination are valuable in the diagnosis of small bowel injury following penetrating trauma, these alone are not sufficiently accurate.

Stabogram to define peritoneal violation by injecting contrast into the stab wound tract and searching for intraperitoneal spillage radiographically and a high false-negative rate causes this procedure to be largely abandoned.

Any patient who has peritoneal signs or haemodynamically unstable proceeds promptly to exploratory laparotomy. Even in stable patients in whom there may not be intra peritoneal injury still laparotomy is indicated for the fear of retained radiolucent foreign body like cloth. In equivocal cases diagnostic peritoneal lavage which is useful in blunt injury but not in penetrating injury. Gunshot wounds present a much greater risk for significant intra- abdominal injury. Consequently all gunshot wounds traversing or in proximity to the peritoneal cavity are explored.

Treatment

At operation, significant bleeding will be the first priority. The small bowel should be carefully examined from the ligament of Tretiz all the way to the

ileocaecal valve. Contusion of the antimesentric wall of the bowel may result in delayed perforation and seromuscular sutures can be used to imbricate the contusion into the lumen. Single holes from stab wounds or shotgun pellets car be closed without debridement. Since penetrating injuries in general occurs in pairs, careful examination of the bowel wall on the opposite side must be done to avoid missing any small perforations. If two adjacent holes are found they can be connected across the bridge of bowel and a transverse closure effected, so as not to narrow the lumen. Any large segments of bowel that are devascularized or have multiple defects, should be resected and re-anastomosed,

Mucosal prolapse is a laparotomy finding in traumatic perforation of duodenum and small bowel; which is absent in pathological perforation- this is of medico legal importance

Complications

Intra-abdominal abscess, anastomatic leakage, enterocutaneous fistula and intestinal obstruction. (Moossa AR. et al). [26]

Colonic injuries

Philip. J,Huber. JR and Ervin.R. Thal et al [30] has summarized the recent concept in the management of colonic injuries in the SCNA. Vol 70 no. 3 June 1990. The conclusions are

1) Primary repair is safe in carefully selected cases.

2) Colostomy should not be abandoned because of a fear of morbidity associated with its closure.

3) The difference between injuries on the right and the left colon is questionable and probably not as significant as previously thought.

4) Exteriorized repair frequently require conversion to colostomy and probably has little indication for use.

5) Short term perioperative antibiotic coverage is sufficient.

6) Wounds are left open in patients with significant contamination.

Protocol

The protocol to be followed in colonic injury is:

i. Retroperitoneal parts of the colon like Ascending & Descending colon.

a) Ascending colon - single layer closure with ileotransverse colostomy.

b) Descending colon - single layer closure with proximal defunctioning transverse colostomy.

ii. Intraperitoneal parts like Transverse colon & Sigmoid colon- brought out as colostomy.

Renal injuries

Penetrating trauma accounts for 84% of renal injuries. The 9reat majority of penetrating renal injuries were gunshot wounds (79%) and the remainders were due to stabbing (Parkland Memorial Hospital Study Dallas 1980).[23] Gunshot injuries produce multiple intra-abdominal and intrathoracic injuries. Stab wounds

to the kidney also were associated with a high incidence of non renal injuries. The overt mechanism of renal injury from penetrating trauma is the obvious tissue disruption to the parenchyma, collecting system and vasculature.

Renal injuries are classified into four types (Sagalowski)

Class I Minor contusion with or without concomitant Subcapsular hematoma

Class II Minor parenchymal laceration or contusion (65 - 70%).

Class III Major parenchymal laceration, usually through the corticomedullary junction and often involving the collecting system.

Class IV Shattered kidney or renal pedicle injuries (10-15%).

Diagnosis

History is very important a high index of suspicion should be there. Flank pain, haematuria warrants evaluation regardless of the apparent location of trauma. The degree of haematuria may bear no relationship to the severity of renal injury. The great majority of renal injuries without haematuria are class III in type and the severe nature of trauma would alert the physician to possible renal injury these cases. Ground glass density in the flank suggests urinary extravasations or hematoma or pre-existing mass such as hydronephrosis or tumor. Evaluation of upper urinary tract proceeds with high dose infusion pyelogram or double dose bolus pyelogram. Standard low dose intravenous urogram has a false negative rate

of approximately 34% (carlton, 1978).[5] Infusion pyelography indentifies approximately 80% of renal injuries. IVU assess the injury and more importantly the status of the opposite kidney.

Renal injury is suggested by the following radiological findings (peters and Sagalowski)[33].

a) Decreased excretion of contrast

b) Obliteration of psoas shadow or renal outline.

c) Scoliosis away from the injury.

d) Extravasations of the contrast

A normal VU with haematuria in a trauma patient suggest minor renal contusion and rules out major renal injury. Incomplete or poor visualization of a portion of kidney suggest major renal trauma, include deep laceration, avulsion or vascular occlusion. Non visualization of a kidney on pylorography requires immediate arteriography whenever possible. CT is very useful investigation helpful in the non-operative management. The other modalities that have limited role include ROP, radionuclide scan.

Treatment

Surgical exploration of all penetrating renal injuries is recommended because of the high incidence of associated intra-abdominal injuries. Severe polar injuries are best treated by guillotine amputation to minimize delayed necrosis and fistula formation. Openings into the collecting systems are carefully closed with

4/0 or 5/0 chromic catgut. Renal capsule may be closed, if hemostasis is adequate. If further hemostasis is required, topical clotting agents such as avitene or oxycel may be applied and mattress sutures through parenchyma may be tied over bolster. Saucerised defects in parenchyma may be covered with omental or peritoneal graft. Shattered kidney requires nephrectomy to prevent hemorrhage (Peters and Bright).[29]Finally flank is drained with Penrose or close suction drain. Renal vein laceration may be repaired by venorraphy. Renal arterial trauma may require a variety of repairs. Lateral arteriorrhaphy (Turner and coworkers 1983), arterial resection and repair by primary reanastomosis or autogenous repair. The role of interventional radiology includes percutaneous drainage of urinomas and infected hematomas. Embolisation is used when there is a persistent or delayed hemorrhage from a segmental vessel.

Ureteric injuries

The following classification of ureteral injury helps in organizing the management of ureteral injury (Sagalowski)[33]

1) Site: Upper, Middle or Lower third

2) Time of recognition immediate or delayed

3) Nature of injury: Blunt trauma with laceration or avulsion, penetrating trauma.

4) Presence of concomitant injuries

Diagnosis of Ureteric Injury

The presence or absence of haematuria is of little help (Carlton, 1978).[5]The ureteric injury should be suspected from the presence of extravasations in the excretory urogram it must be suspected in all abdominal gunshots. CT scan is more accurate in detecting the extravasations preoperatively. When the ureter injury is not made out during the initial exploration then it may have delayed presentations (Peter & Bright, 1976).[29] Retrograde pyelography gives one of the most precise preoperative study to localize the site and magnitude of the extravasations (Benson). It determines whether the lesion is complete or partial. Percutaneous antegrade technique also may be sometimes helpful when there is hydronephrosis.

Management

In patients in whom there is not complete disruption of the ureteral continuity, passage of a double 'J' ureteral stent with drainage may be all that is necessary. (Hoch et al, 1975).[11] Uretropelvic junction disruptions and major upper ureteral injuries (greater than 2 cm laceration) are best treated by nephrostomy and stent, after repair with fine catgut sutures. Drainage should be provided. Lower ureteral injuries usually require tunneled reimplantation into the bladder, if this is not possible then a flap should be turned cephalad for reconstruction (Boari and Ockerland). When major ureteral loss is present or when it is necessary not to have any ureteral leakage postoperatively, one may ligate the ureter and perform

nephrostomy either at the time or percutaneously within 24 hours, then later doing a transuretero — ureterostomy, if there is no contraindication (Hodges et al, 1963),[12] Alternatively one may choose substitution of a segment of tapered or non tapered ileum for the ureter. Nephrectomy may be the procedure of choice when there is simultaneous injury to the colon, ureter and iliac artery or aorta.

Retroperitoneal Hematoma[23]

The exact incidence of retroperitoneal hematoma in patients who have suffered penetrating abdominal injuries is usually not recorded as the hematomas are simply a manifestation of a major vascular injury.

In general, trauma surgeons recognize retroperitoneal hematoma in five locations. They are as follows.

Midline suprarenal,

Midline infrarenal,

Lateral peri renal

Lateral pelvic and portal[13,14]

Anemia and hematoma are constant findings in patients with retroperitoneal hematoma from pelvic fractures, while hematuria is much less common in patients with hematomas caused by penetrating wounds involving vascular structures. A plain film in a patient with penetrating wound from a missile will localize the site of the missile and give some indication of major retroperitoneal vascular structure has been injured.

In contrast to the management of retroperitoneal hematoma with blunt abdominal trauma, all five retroperitoneal hematomas previously listed are opened in patients with penetrating wounds. In each instance, proximal vascular control and if possible distal vascular control should be done before entering the hematoma.

Retro hepatic venous injury

This injury can test the endurance and fortitude of the trauma surgeon to the limit. If retrohepatic bleeding can be stopped by repositioning the liver against the diaphragm, a direct approach may be tried initially. If this fails one is left with two options:

a) Insertion of an atriocaval shunts (Schrock. T et all 986)

b) An alterative approach used is extensive thoracotomy to expose and repair or ligate the injured retrohepatic vessel (Pachter et al 1986).

THE NATURE OF STABING WEAPONS

Knives are the weapons most frequently involved and their physical characteristics are important in shaping the wound. A forensic pathologist is called to examine a knife that may have been used in assault should note and measure:

1. The length, width and thickness of the blade.
2. Whether it is single or double edged.
3. The degree of taper from tip to hilt.
4. The nature of the back edge in a single-edged knife (ex: serrated or squared off).
5. The face of the hilt guard adjacent to the blade.
6. Any grooving, serration or forking of the blade.
7. Most importantly, the sharpness of the edge and especially of the extreme tip of the blade.

Other knife-like weapons include *scissor, chisels, swords, open razors* and sharp tools of any kinds such as sharpened *screwdriver*. Larger cutting instruments such as *axes, choppers, parangs, machetes and pangas*. Agricultural implements like *shears, bill-hooks, hay knives* and many others are used as stabbing weapons when used by a point rather the long edge.

Figure 1: Sickle (arivaal), Figure 2: Dagger, Figure 3: Hunting knife, Figure 4: Folding fillet knife, Figure 5: chisel.

MATERIALS AND METHODS

This study consists of all penetrating abdominal injuries admitted in the trauma ward of government Rajaji hospital, Madurai from October 2007 to October 2009. Once the patient is admitted the name, age, sex and mode of injury are noted. The time interval between injury and admission and time interval between admission and surgery are recorded. After retesting the patient and if time permits necessary investigation carried out. In those who are operated, the operative findings and methods of management are recorded. Cases are followed up till their discharge from the hospital. If death occurs the cause of death is evaluated. In those patients who died before surgery the postmortem findings are noted. The above facts are in a proforma prepared for this study.

OBSERVATION

The total number of patients who had sustained penetrating abdominal injuries were 50 in this study of 50 patients, 38 were male and 12 cases were females. This gives a male to female ratio of 3.2:1. The high incidence of trauma in males may probably be de to the relatively high association of males in acts of violence of vehicular accidents.

Table 1: AGE AND SEX INCIDENCE:

Age group in yrs	Male	Female	Total
<10	Nil	Nil	Nil
11-20	4	Nil	4
21-30	16	2	18
31-40	10	4	14
41-50	4	4	8
51-60	3	1	4
>60	1	1	2
Total	38	12	50

The youngest patient was a 13 yr old boy who had sustained penetrating abdominal injury by accidental fall over the Iron rods. More than 60% of the patients belong to the age group between 21-40 years which in the most

productive part of one's life. The oldest patient was a 68 yr old female who had sustained penetrating injuries by bull gore.

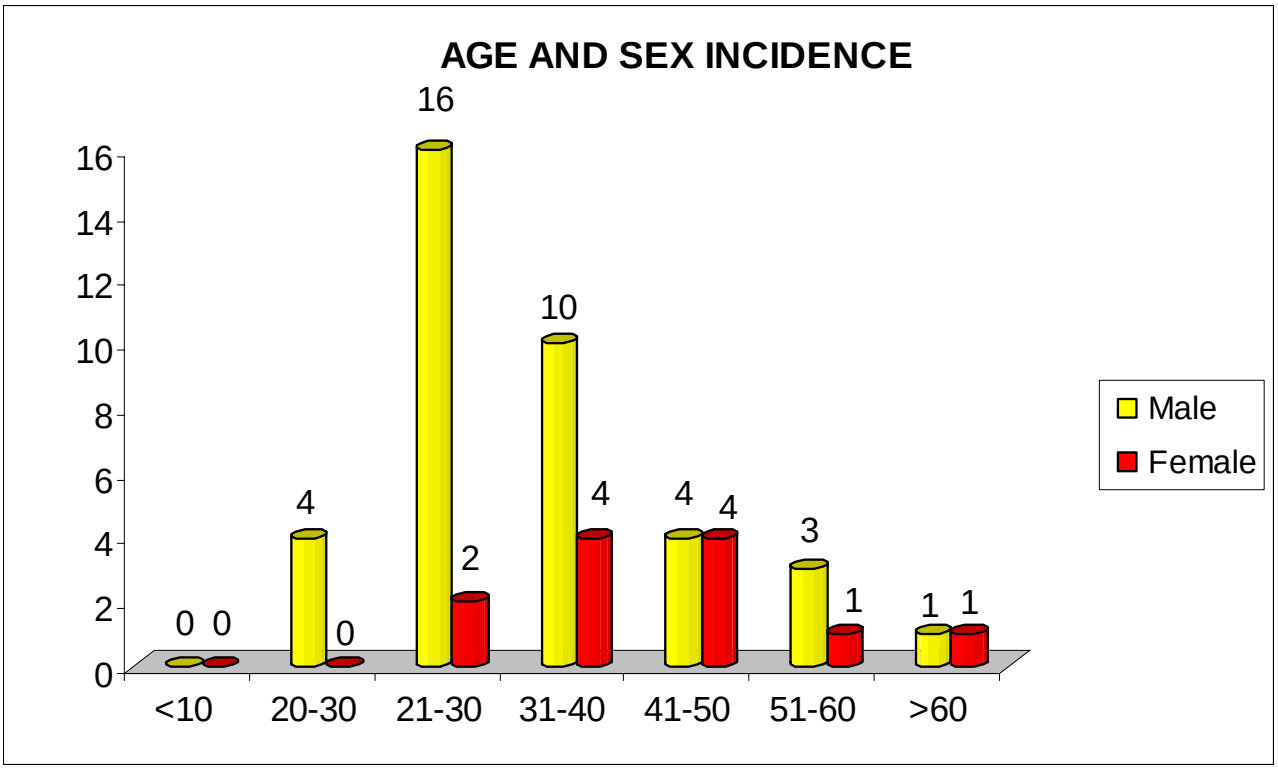


Table 2: MODES OF PENETRATING ABDOMINAL INJURIES:

Stab injury	32	64%
Bull gore	12	24%
RTA	4	8%
Others	2	4%
Total	50	

As given in the Table 2. Stab injury is the common penetrating trauma accounting 64%. Therewere12 cases of bullogre injury. 4 cases of RTA, 2 cases due to falling on iron rods in a concrete centering work site (accidental fall).

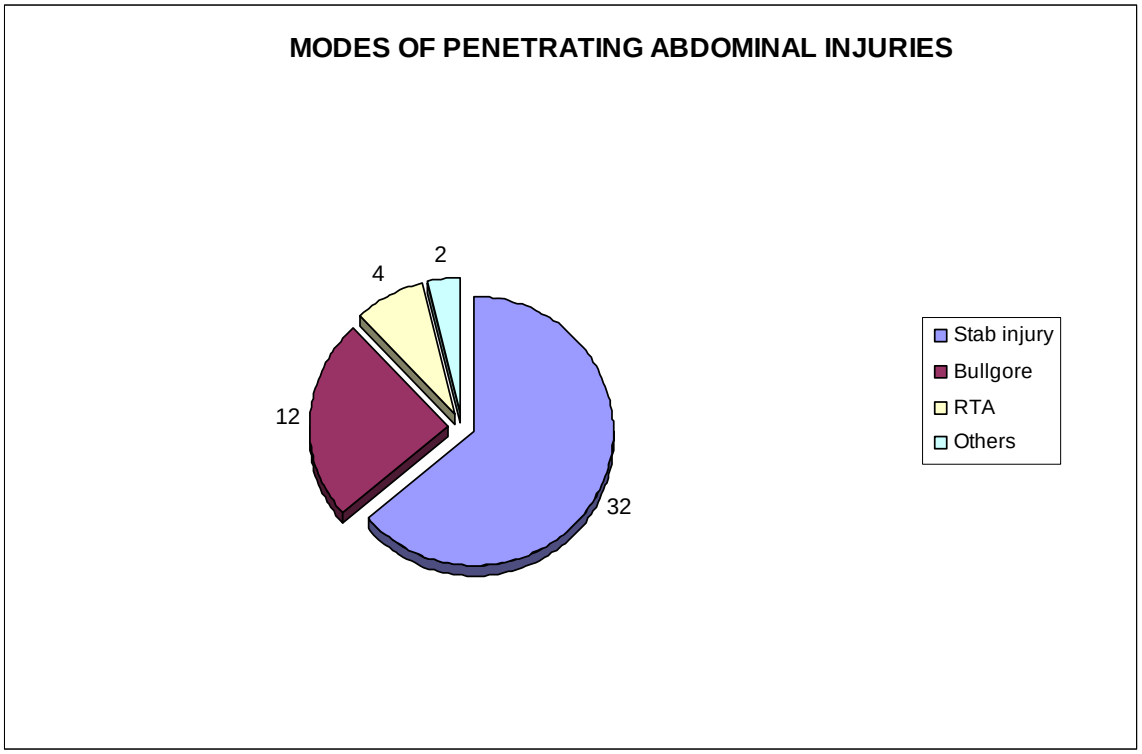


Table 3: INJURY OF THE OTHER ORGANS:

Thoracic injuries	12	24%
Long bone injuries	10	20%
Head injuries	4	8%
Others	2	4%
Total	28	56%

Table 3: Shows the associated injuries in penetrating abdominal injuries. 12 patients sustained associated thoracic injuries. 10 patients had long bone fractures. 4 patients suffered from head injuries. 1 patient sustained cut throat injury. 1 patient had pelvic bone fracture. Totally 28 patients (58%) had injuries involving other organs. This high incidence of polytrauma with penetrating injuries abdomen indicates the severity of injuries.

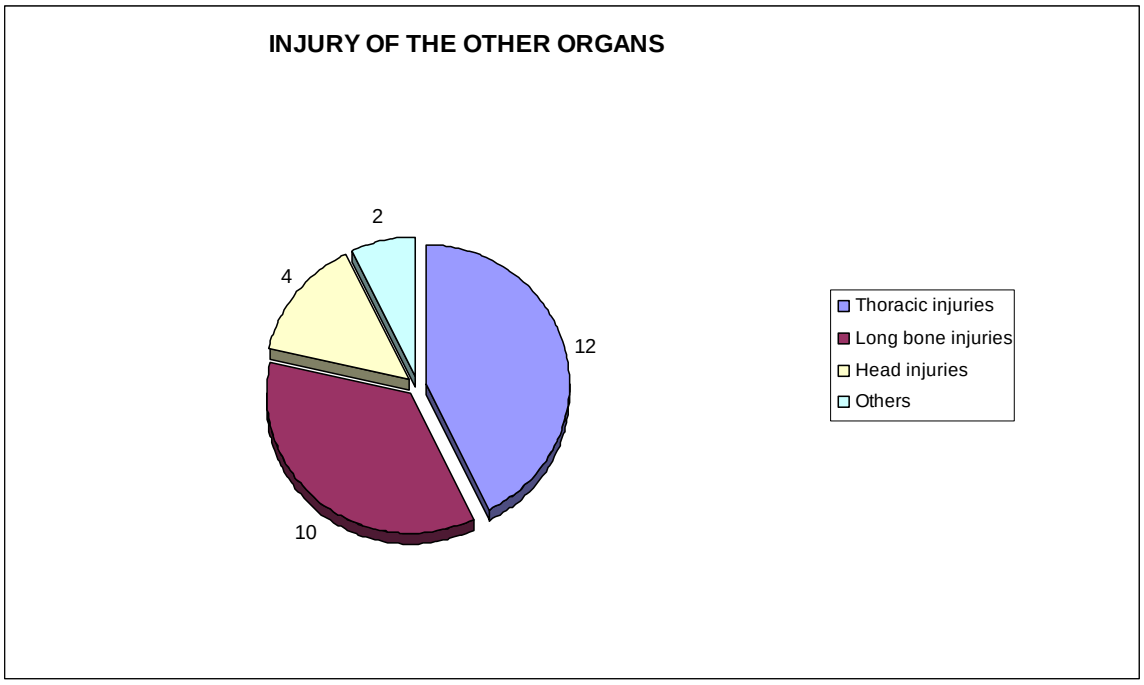


Table 4: The analysis of the time interval between injury – admission and admission – surgery:

Time internal	Injury – Admission	Admission - Surgery
<2 hrs	18	12
2-4 hrs	12	18
4-6 hrs	8	8
6-8 hrs	4	2
8-10 hrs	3	1
10-12 hrs	3	4
> 12 hrs	2	5

Table 4: shows 38 cases took less than 6 hrs from time of injury to admission. The fastest to arrive was within 30 minutes from the injury.

The average time duration between admission and surgery was 4 hrs.

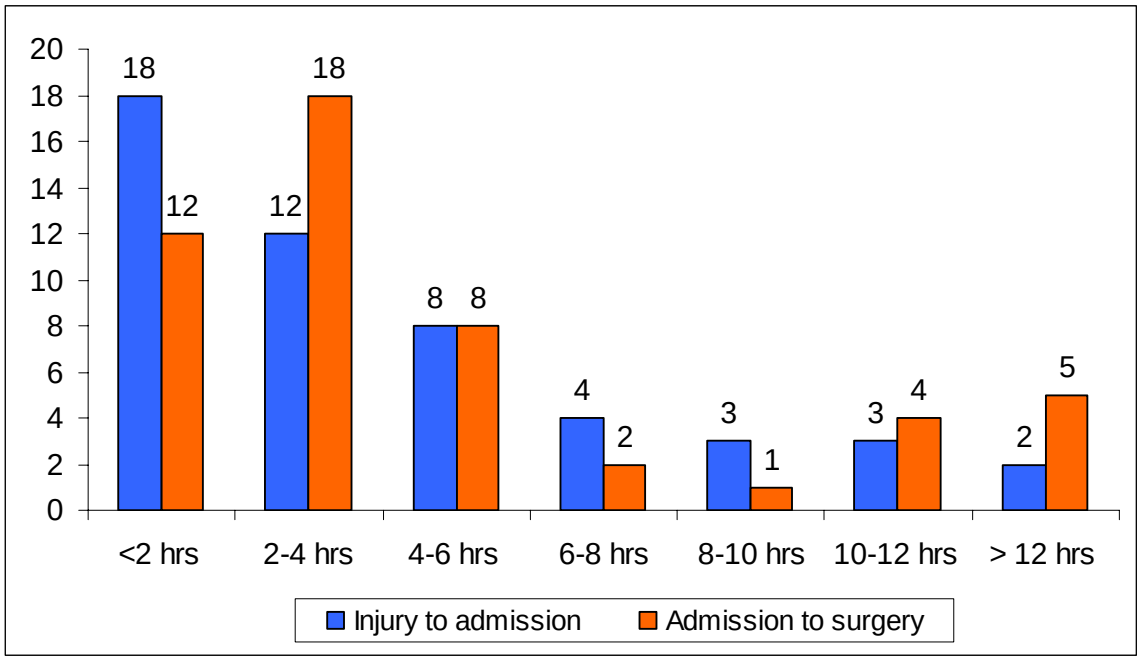
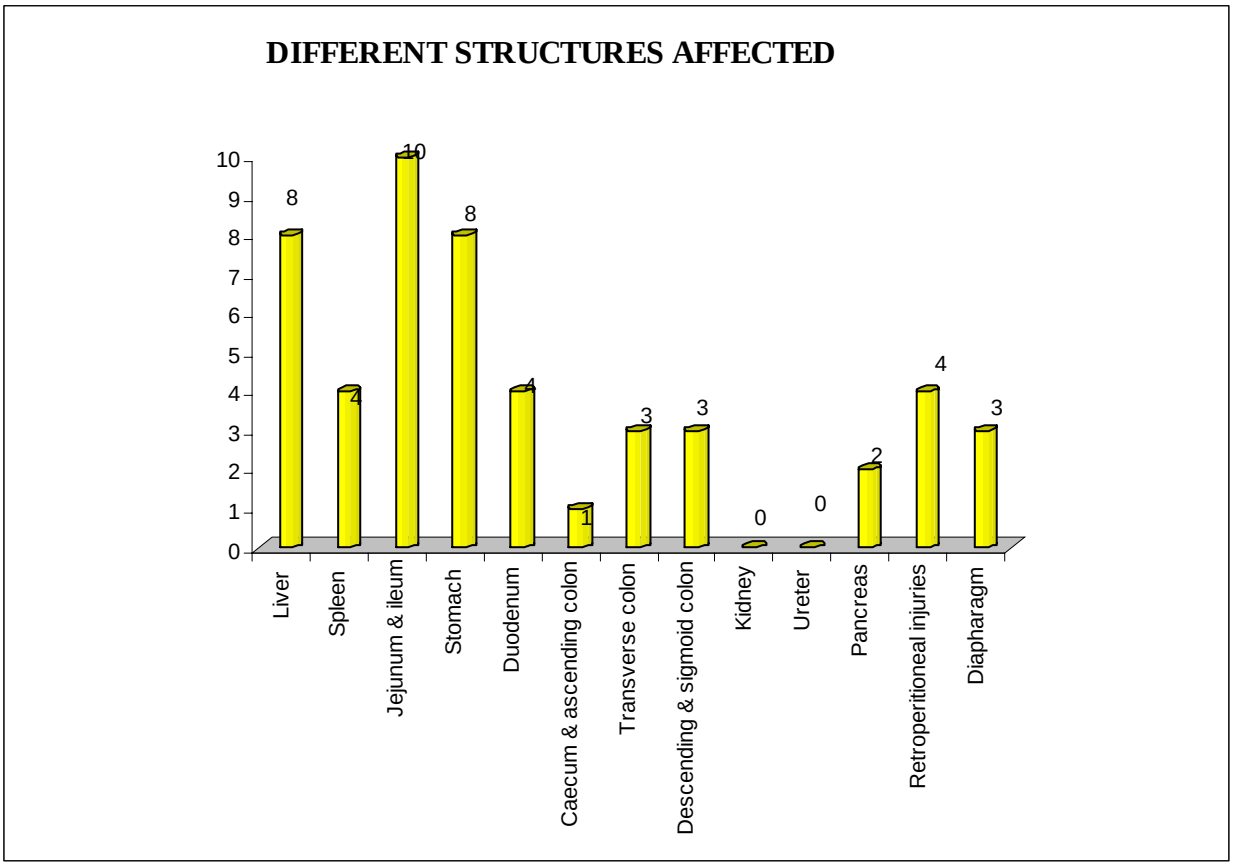


Table 5: DIFFERENT STRUCTURES AFFECTED:

Liver	8
Spleen	4
Stomach	8
Duodenum	4
Jejunum & ileum	10
Caecum & ascending colon	1
Transverse colon	3
Descending colon & sigmoid colon	3
Pancreas	2
Diaphragm	3
Retro peritoneal injuries	4

Table 5: shows the incidence of hollow viscous injury in 29 cases accounting about 58%. Different organs injured in the study, small bowel tops the list with 10 cases. This is followed by the stomach and liver injury – accounting to 8 cases each, there were 4 cases of spleen, duodenum, and Retroperitoneal hematomas, 3 cases of transverse colon and 3 cases of sigmoid colon, 3 cases of diaphragmatic injuries, 2 cases of pancreas and 1 case of caecum injury.


DIFFERENT STRUCTURES AFFECTED
10
9
8
7
6
5
4
3
2
1
0
8
4
10
8
4
1
3
3
0
0
2
4
3
Liver
Spleen
Jejunum & ileum
Stomach
Duodenum
Caecum & ascending colon
Transverse colon
Descending & sigmoid colon
Kidney
Ureter
Pancreas
Retroperitioneal injuries
Diapharagm

DISSCUSSION

Liver Injuries

There were totally 8 cases of liver injury, in this 6 cases were due to stab injury and 2 cases were due to bull gore. The commonest cause of penetrating liver injury in Ben Taub General hospital, Hauston was Gunshot wounds accounting for 50.60% and stab injuries accounting for 33.90%. The incidence of associated organ injuries is a significant factor in patients sustaining liver injures. In this study only 3 cases were isolated liver injuries and remaining were associated with other organ injuries. The different ways in which the 8 cases of liver injuries were managed as follows, application of Gel foam and suture hepatorraphy was done in 5 cases. In 1 case there was no active bleeding hence no repair done. In 1 case shattered liver present so segmental hepatectomy done. In 1 case omental pack was kept in deep lobar laceration to control bleeding. Peritoneal lavage with normal saline and open drainage was kept in all cases.

In this study 2 out of 8 cases died giving morality rate of 25%. Mortality in our case was due to the severe associated injuries and one died of septicemia at the end of the 4^{th} post operative day. Two cases developed subphrenic abscess.

The Mortality rate at the Ben Taub General hospital in Houston from 1979 to 1984 was 10-15%[23]. The incidence of post operative perihepatic abscess range from 3.5% to 22% (Feliciano DV et all)[7]. Post operative perihepatic abscess was diagnosed clinically in the patients who remained continuously febrile after 5-7

days and had persistent leucocytosis and foul smelling drainage from open drainage. All the patients were treated conservatively. One patient develops pneumonia with hyperpyrexia and it was confirmed by x-ray chest and treated conservatively. In this study no complication of biliary leak.

Splenic Injuries

There were totally 4 cases of splenic injury. Of these 4 cases 3 cases were due to stab injury and 1 case was due to bull gore injury, where as the series form the Ben Taub General hospital in Houston has reported an incidence of gunshot splenic injury as 7.6% and stab injuries as 7% among penetrating splenic injuries[23].

In this study only one case had isolated splenic injuries. 1 case was associated with diaphragmatic injuries and 1 case had associated pancreatic injury with retroperitoneal hematoma. 1 case was associated with stomach and small bowel injury.

In this study all the injured spleen have undergone splenectomy. Whereas the series from Ben Taub Hospital, Houston report 45-50% of injured spleen have undergone repair instead of splenectomy that too splenorrhaphy was accompanied in 51% of patients with penetrating mechanism of injury.

The grading of the splenic injury has a significant impact on treatment. In out study out 4 patients, 3 patients were haemodynamically unstable and had

associated intra abdominal injuries, so we could not perform splenorrhaphy for these patients.

In this study two cases died in the immediate post operative period due to hypovolumic shock and multiple organ failure. 2 patients had fever ranging from 99^0F to 102^0F upto 4^{th} post operative day and 1 patient had consolidation of the left lower lobe. All of them are treated conservatively with antibiotics and antipyretics. Three patients had wound infection.

Stomach Injuries

There were totally 8 cases of stomach injuries. In this 6 cases were due to stab injuries, 1 case due to Bull gore and 1 case due to RTA. Where as the series from Ben Taub Hospital report an incidence of Gun shot stomach injuries as 17.3% and stab stomach injuries as 12.6%[23,7].

In this study isolated stomach injury was present in 3 cases. All remaining cases were associated with other organ injuries, of which retroperitoneal haematoma was present in 3 cases, liver injury in 2 cases, splenic injury in 1 case, duodenal injury in 1 case, diaphragmatic and small bowel injury in 1 case. Pre operatively all cases were confirmed by the passage of bright red blood through Ryle's tube and the presence of free air in X-Ray abdomen. In this study in all stomach injuries, the entrance and exit sites of the penetrating wound were visualized. Then the stomach was closed in two layers utilizing an inner

continuous suture with 2-0 vicryl (or) catgut in full thickness manner. This layer is then imbricated with sero muscular layer of interrupted Lambert sutures using 2-0 or 3-0silk. In one patient after gastrorraphy AGJ and JJ was done and that patient died of septicemia on 4th post operative day. One more patient died of multiorgan failure due to concomitant liver and small bowel injuries. One patient developed consolidation of left lower lobe with left subphrenic abscess and three patients had wound infection and all by them treated conservatively. In all cases peritoneal lavage done with normal saline and open drainage kept.

Duodenal injuries

There were totally 4 cases of duodenal injuries of which 3 cases due to stab injury and 1 case due to bull gore. According to six recent series the incidence of penetrating duodenal injury was 85% and blunt duodenal trauma was 15% (SCNA Vol70 No: 3 June 1990). All patients were taken up for exploratory laporotomy. All patients underwent duodenorrhaphy in 2 layers. 2 patients underwent gastrojejunostomy, in 2 patients a serosal jejunal patch was kept. One patient tube decompression of duodenum was done. John A Weigelt also states that 80% of patients with duodenal injuries require simple duodenorrhaphy.

Synder et all 1980[34] could find no difference in the morbidity of simple closure with (or) without tube decompression.

In this study one case died 5th post operative day due to septicemia and concomitant liver and colonic injuries. But this may not reflect the real problem because the number of cases studied was too small and the period of study was also short. Levison et al 1984[21] in a recent series reports a mortality of 16.7% for blunt duodenal trauma and mortality of 7.5% for penetrating duodenal trauma.

Incidence of duodenal fistula in our study was 15%.

Pancreatic Injuries

There were totally 2 cases of pancreatic injuries. Of which one case was due to stab injury and one case was due to bull gore injury. Gregory .J. Jurkovich states that penetrating trauma accounts for two third and blunt trauma accounts for one third of pancreatic injuries. In our study 95% of the patients had associated organ injuries which are in accordance with the reports of Balasegaram.M. 1979, Graham. J M. et al 1978, Smego .DR et al 1985, and Stone .HH et al 1981.

One patient was taken up for cystojejunostomy as he presented with pseudocyst of pancreas. In one patient who had multiple stab injury of the bowel with pancreatic injury, had surgery done outside and was referred to our center with enterocutaneous and pancreatic fistula.

In this study the mortality rate for pancreatic injury was 50%. The combined mortality from several large series of pancreatic trauma patients range from 10- 25% (SCNA Vol 70 No. 3 June 1990).[17] our morbidity rate was 70%. In

this study the incidence of pancreatic fistula was 50% which healed with conservative management.

Jejunum and Ileum Injuries

There were totally 10 cases of small bowel injuries. Of which 7 cases were due to stab injury and 2 cases were due to bull gore injury and 1 case was due to accidental fall injury. Whereas the incidence of small intestinal injury following penetrating trauma exceeds 80% with gunshot wound and 30% with stab injuries that penetrate the peritoneum (SCNA Vol - 70 No. 3 June 90)[17,23]

In this study only 3 cases had isolated small bowel injury. In the remaining 4 cases had associated mesenteric tears, one case was associated with colonic injuries and other two cases were associated with liver, spleen and stomach injuries separately.

After laparotomy, thorough search for wounds from the ligament of Treitz to the ileocaecal valve was done in all small bowel injuries. In this study, three cases of hematomas and serosal lacerations of small bowel were ‘Turned In’ using Lembert sutures placed in a transverse fashion. In 3 cases with questionable viability of bowel, we have done resection and anastomosis in 2 layer transversely using inner continuous 2/0 vicryl and outer lembert sutures with 2/0 silk. In all cases thorough peritoneal irrigation with saline done and open drainage was kept.

In this study one case died due to concomitant colonic injury, because the number of cases studied was too small this may not reflect the real problem. In our

study two patients had wound infection and two had intrabdominal abscess, both of these were treated with conservative management.

Caecum and ascending colon injury

There was only one isolated case of caecal injury due to stab injury. There was laceration of caecum and mild hematoma in mesentry, which was sutured in 2 layers using 2-0 vicryl and 2-0 silk. Thorough laparotomy done and peritoneal irrigation with saline done and open drainage kept.

Post operative period was uneventful, and patient recovered well. On 6^{th} day there was wound infection, which was treated conservatively.

Transverse colon injuries

There were totally 3 cases of transverse colon injuries. 2 cases were due to stab injury and 2 cases due to bull gore injury. 2 cases were small laceration of transverse colon and hematoma in mesocolon which was repaired by lembert sutured transversely with 2-0 silk. One patient had transverse colon transaction and mesocolon rent, which was repaired after trimming the edges and confirming the viability, anastomosis done in 2 layers using 2-0 vicryl and 2-0 silk. Peritoneal lavage done with normal saline and open drainage kept.

In this study all three cases were recovered better and 1 patient had wound infection, which was treated with conservative management.

Descending and Sigmoid Colon Injuries

There were totally 3 cases of injury to the sigmoid colon. 2 cases due to stab injury and 1 case due to bull gore injury. The bull gore injury case had associate injury to the scrotum. 2 cases had perforation of the sigmoid colon with sigmoid mesocolon rent. Both the cases were treated with primary 2 layer closure with 2-0 silk. In 3rd case there was laceration of sigmoid and ascending colon, in this resection and anastomosis done in 2 layer using 2-0 vicryl and 2-0 silk. Proximal covering transverse colostomy done, thorough peritoneal lavage given with normal saline and flank drain kept.

In all 3 cases postoperative period was uneventful. One case had wound infection at 5th postoperative day, which was treated conservatively.

Retroperitoneal hematoma

There were 3 cases of mild retroperitoneal hematoma which were associated with other injuries. Nothing specific was done for these hematomas. All patients had uneventful recovery.

Diaphragmatic injuries

There were totally 3 cases of diaphragmatic injuries. Of which 2 cases were due to stab injury and one case was due to bull gore injury. All cases were associated with intrabdominal injuries of which, two cases were associated with

splenic injuries and one case was associated with combined stomach and splenic injuries.

In this study, after laparotomy only in one case we had converted into thoracoabdominal incision and in remaining cases repair was done through abdominal approach only. The rent was closed with simple sutures with 1- prolene or with other non absorbable suture materials or with figure of eight sutures of the same material. In all cases ICD was done after closure. One patient died on 4th postoperative day due to septicemia.

Negative celiotomies

In this study there were 4 cases of negative celiotomies. Where as in Feliciano et al 1984, [17] Shorr et al 1988, [23] series, the negative celiotomies were from 5.8% to 7.4%. In this study after confirmation of peritoneal penetration by wound exploration, exploratory laparotomy was done in all cases. There was no viscous or vascular injury, and there was no missed injury in our study. All were discharged after an uneventful post operative period.

MORTALITY AND MORBIDITY

There were totally 6 deaths in this study of 50 cases, constituting a mortality rate of **12%**. Morbidity in mild to severe forms occurred in all patients who survived.

The breakup of the death cases is as follows:

Splenic injury	2
Shattered liver injury with retrohepatic venous injury	2
Pancreatic injury	1
Diaphragmatic injury	1

The severe degree of morbidity occurred in the form of residual abscess, duodenal fistula, pancreatic fistula, post operative lung infections etc, the mild form of morbidity were due to surgical site infection.

Spjut-patrinely.V, Feliciano.DV, Ben Taub General hospital, Houston has reported in a series of 300 consecutive patients with penetrating abdominal injuries, a overall mortality rate of 15%. In our study the mortality rate was 12% and it included only those patients arriving to the hospital alive. Hence the prehospital mortality having been excluded and 12% mortality rate is comparable with literature.

CONCLUSION

1. The incidence of hollow viscous injury in penetrating abdominal injury in my study is about **58%**.
2. In my study stab injury is the common mode of producing penetrating abdominal injuries.
3. In my study more than 60% of the patients belong to the age group between 21 - 40 years which is the most productive part of one's life.
4. In my study male to female ratio was 3.2: 1 and the high incidence of trauma in male may probably due to the relatively high association of males in acts of violence and vehicular accidents.
5. Liver, small bowel and stomach are the 3 most frequently injured organs.
6. There was no appreciable delay in the management of majority of the patients because of the penetrating nature of injuries.
7. The overall mortality of penetrating abdominal injuries in this study was 12% and morbidity was 80%.
8. Septicemia and Hypovolumic shock due to bleeding was the major causes of death.

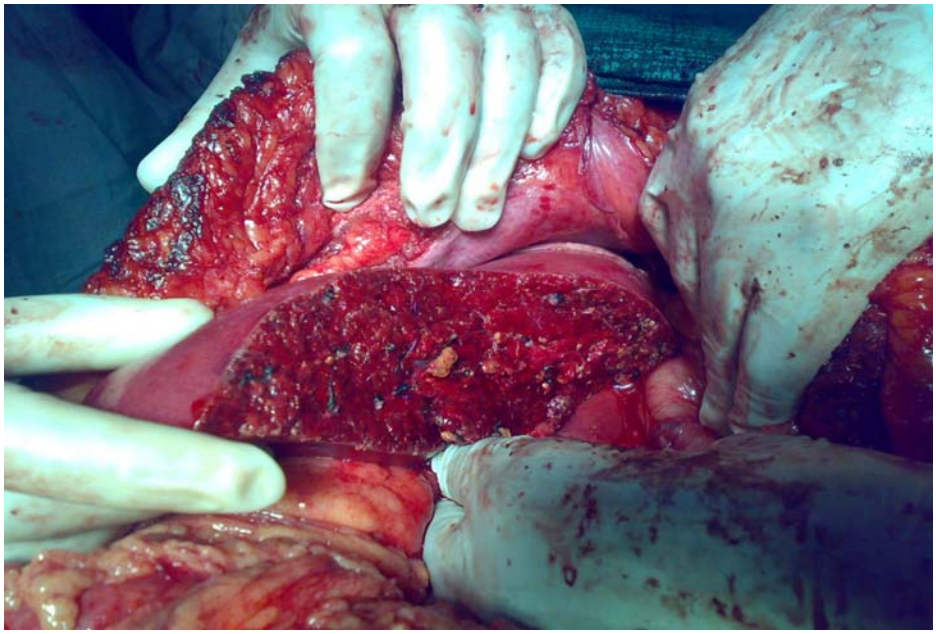
BIBILIOGRAPHY

1. Balasegaram M: Surgical Management of Pancreatic trauma. Curr Probl Surg 16(12: 1-59, 1979
2. Berne CJ, Donovan AJ, White EJ et al: Duodenal “diverticulization” for duodenal and pancreatic injury. am.j.surg 127:503-507, 1974
3. Blaisdell EW, Trunkey DD Trauma Management, Volume I Abdominal trauma. New York, Thieme—Stratton, 1982.
4. Butain WL, Lynn HB; Splenorrhaphy, changing concepts for traumatized spleen: Surg 86: 148 1979
5. Carlton CE: Jr. Injuries of the kidney and ureter. In Harrison, JH et at (Eds) Campbell’s urology. Vol.1 4th Edition, 1978.
6. Flint LM, McCoy M, Richardson JD, et al: Duodenal injury: Analysis of common mis conceptions in diagnosis and treatment Ann Surg 191(6): 697-702, 1980.
7. Feliciano DV: Patterns of injury, Mattox KL, Moore EE, Feliciano DV: Trauma, I edt. Norwalk, CT Appleton & Lange, 1988
8. Graham JM, Mattox KL, Jordon GL: Traumatic injuries of the pancreas. AM J Surg: 136(12): 744-748, 1978
9. Grieco J Perry J — Retroperitoneal hematoma following trauma J. Trauma 20:733, 1979

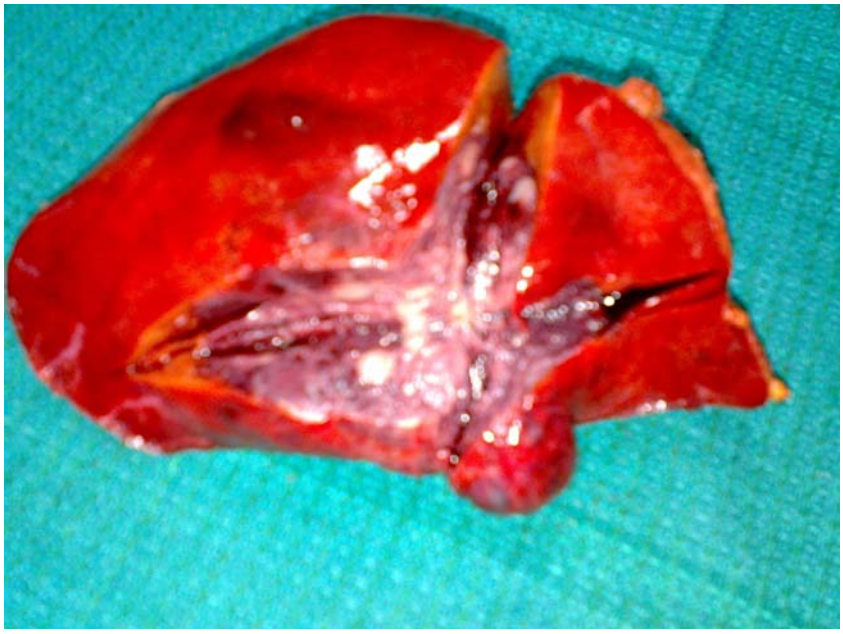
10. Heitsch RC, Knutson CO, Fulton RL, et al: Delineation of critical factors n the treatment of pancreatic trauma. Surgery 60(4): 523-529. 1976
11. Hoch WH, Dursh L, Persky L et al: Early aggressive management of intraoperative ureteral injuries J.Uro, 144:530, 1975
12. Hodges CV. Moore RJ, Lehman TH and Benham AM, Clinical experience with transureteroureterostomy. J. Uro 90:552, 1963
13. Hol croft JW, Trunkey DD et al: Renal trauma and retroperitoneal hematomas indication for exploration J trauma 15:1045 1975
14. Ivaturary RR, Nallathambi M, Gaudino J et al Penetrating duodenal injures Analysis of 100 consecutive cases, ann Surg 202(2): 153-158, 1985
15. Jones RC: Management of Pancreatic trauma: ann Surg 187(5) 555-564, 1978
16. Jeffrey RE, Federle Md, Craess RA Computed tomography of Pancreatic trauma, Radiology 147(5):491 -494, 1983
17. Jurkovich GJ, Surgical clinics of North America Vol 70 No:3 June 1990.
18. Kelly G, Norton L, Moore G et al: The continuing challenge of duodenal injuries trauma 18(3) 160-165, 1978
19. Kind H, Shumacker HB: splenic studies, ann surgery 136-239; 1952
20. Last RJ. Anatomy 8th Edition
21. Levison MA, Peterson SR, Sheldon GF et al: Duodenal trauma experience of a trauma center. J. trauma 24(6): 475-480, 1984

22. Lucas CE, Lederwood AM. Factors influencing outcome after blunt duodenal injury J.trauma 15(10) 839-846, 1975
23. Maingot.R. In Maingot's Abdominal operations 10th Edition
24. Moaninch JW, Carrol PR: Renal trauma, Kidney preservation through improved vascular control-A refined approach. J.trauma. 22:285, 1982
25. Moore EE, Shacford SR, Pachter HL, et al: organ injury scaling: spleen, liier and kidney j.trauma 29:1664, 1989
26. Moosa A.R., A Cuschiari, G.R. Giles Essential Surgical Practice, 2nd Edition
27. Ochsner JL, Crawford ES, Debakey ME: Injuries of the vena cava caused by external trauma. Surgery49:397-405, 1961
28. Pate) J, Williams JS, Shmigel B at a) preservation of splenic functions by auto transplantation of spleen in man, Surg 90:683, 1981.
29. Peters PC and Bright TO Ill: Blunt Renal Injuries Uro Clinic North America 4:17, 1977.
30. Philips. J. Huber. Colonic Injuries. SCNA Vol 70: No. 3 1990.
31. Peitzman AB, Makaroun Ms, Slasky 85 at al. Prospective study of computed tomography in initial management of Blunt abdominal trauma. J.trauma 26(7) 585-592, 1986.
32. Pisters PW, Pachter HL. Autologus Splenic transplantation for spenic trauma. Ann Surg2l9:225 1994.

33. Sagalowsky I. and Paul 0. Peters. Genito urinary Trauma. Campbell's urology
34. Snyder WH Ill et al: The Surgical Management of duodenal trauma, Arch Surg: 115:422-429. 1980.
35. Steichen FM, Dargan EL et al: The management of retroperitoneal hematoma secondary to penetrating injuries Surg gynecol obstet 123:581 1966.
36. Touloukiann R. Splenic preservation in children world J surg 9:214:1985
37. Traub A.Giebink GS Smith C. et al Splenic recticuloendothelial function after splenectomy, splenic repair and splenic auto transplantation. N Eng J med 317:1559, 1987
38. Weigelt AJ. Duodenal lnjuries.SCNAVoI.70 No: 31990

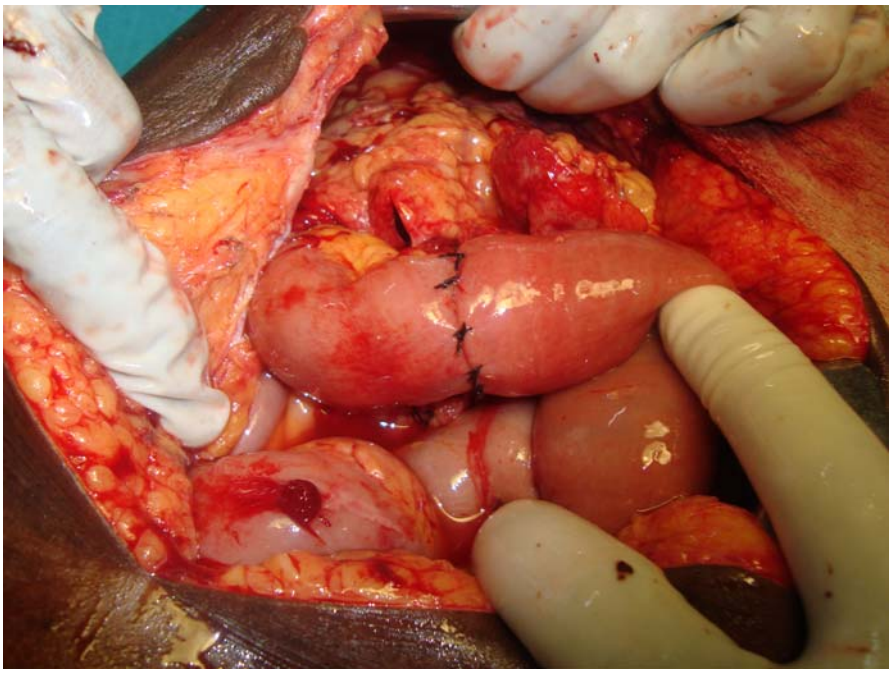


LEFT LOBECTOMY DONE

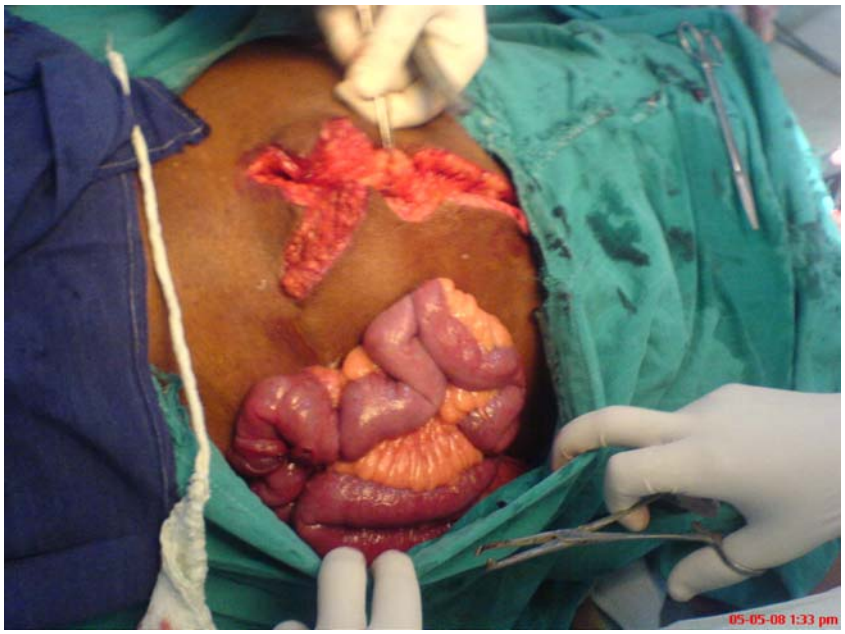


SHATTERED LT LOBE OF LIVER - SPECIMEN

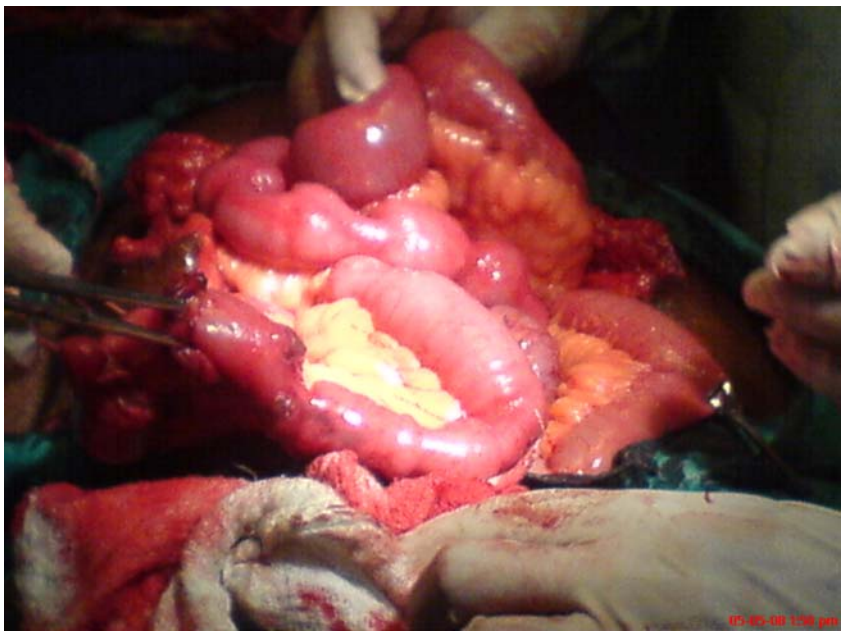
STAB INJURY – JEJUNAL PERFORATION



RESECTION AND ANASTOMOSIS



STAB INJURY WITH MULTIPLE JEJUNAL AND ILEAL PERFORATION

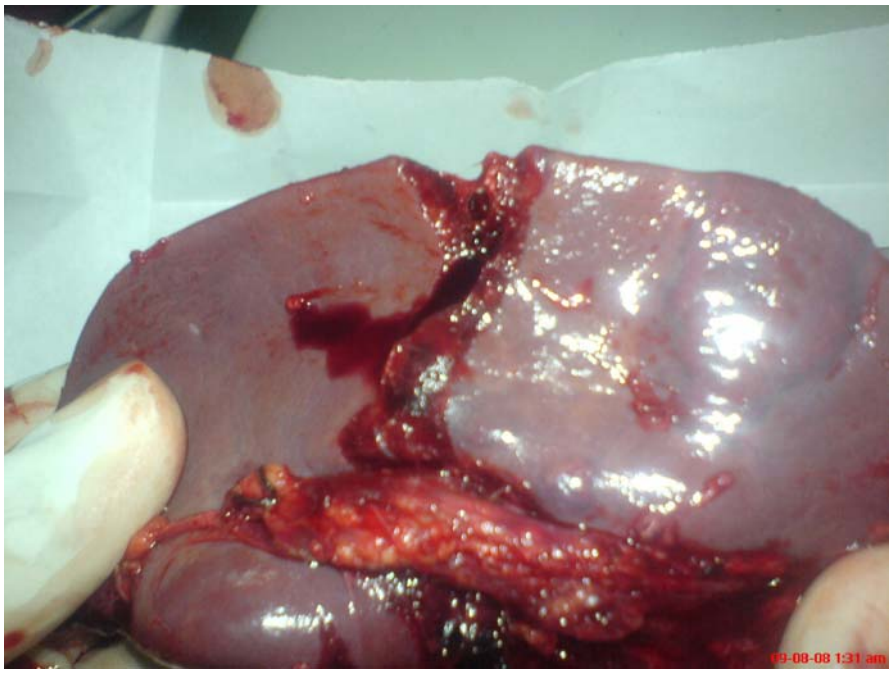


RESECTION AND ANASTOMOSIS

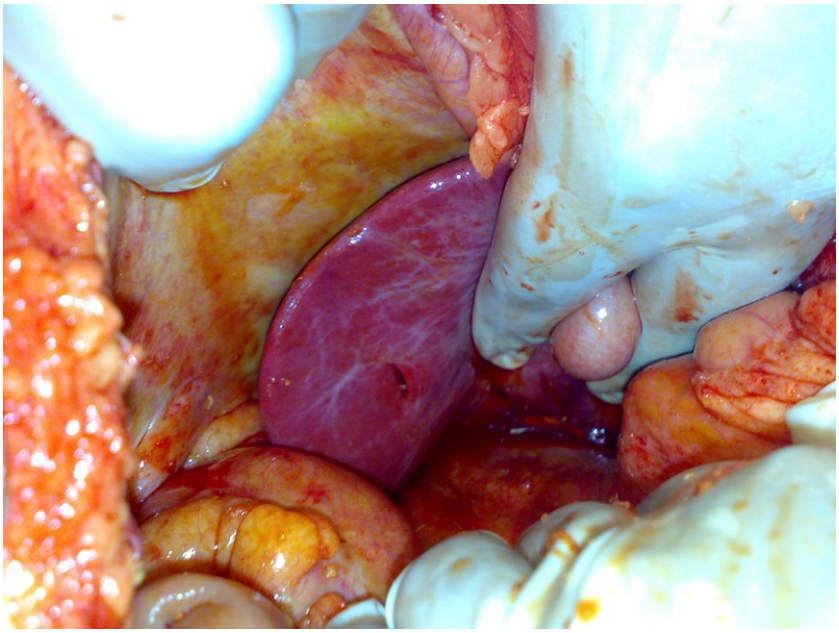
STAB INJURY - LEFT HYPOCHONDRIUM

STOMACH PERFORATION

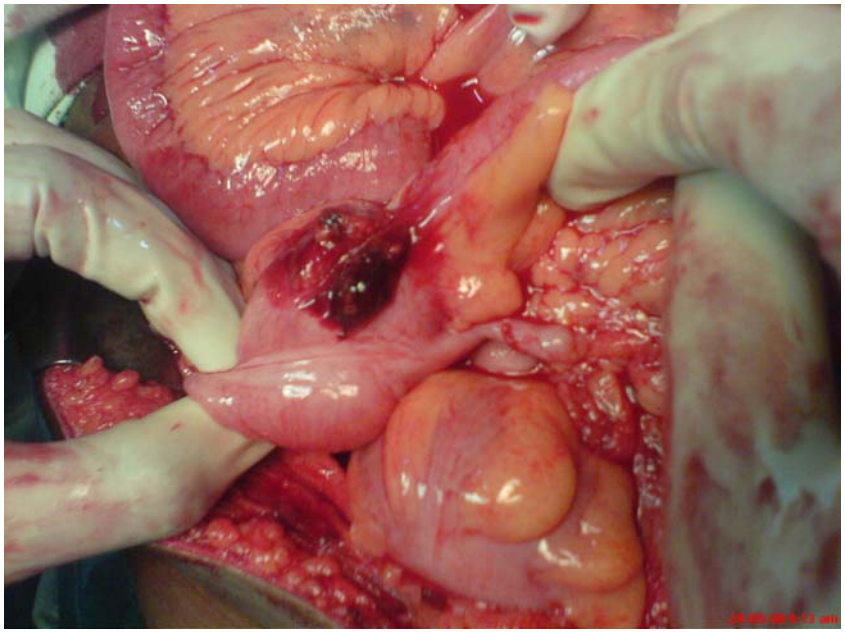
SPLENIC LACERATION – GRADE III



SPLENECTOMY SPECIMEN



LIVER LACERATION - SEGMENT VI



CAECUM PERFORATION WITH HEMATOMA

PENETRATING ABDOMINAL INJURIES

PROFORMA

Name: Age: Sex:

Occupation:

Date & time of injury:

Date and time of admission:

Time interval between injury and admission:

Nature of injury:

i. STAB ii. Bull gore ii. RTA iv. Others

Clinical parameters on admission:

Consciousness: Pulse: BP:

Respiration : CVS: Urine output:

Abdominal findings:

Associated injuries:

i. Head Injury ii. Thoracic iii. Fractures iv. Others

Investigations:

Hb% Urine:

Blood sugar Urea: Creatinine Amylase

Radiological findings:

Date & time of surgery:

Time interval between injury & surgery;

No of blood transfusion:

Operative findings:

Procedure done:

Complications and its management:

Prognosis:

Post mortem findings in cases of death:

BIBILIOGRAPHY

1. Balasegaram M: Surgical Management of Pancreatic trauma. Curr Probl Surg 16(12: 1-59, 1979
2. Berne CJ, Donovan AJ, White EJ et al: Duodenal “diverticulization” for duodenal and pancreatic injury. am.j.surg 127:503-507, 1974
3. Blaisdell EW, Trunkey DD Trauma Management, Volume I Abdominal trauma. New York, Thieme—Stratton, 1982.
4. Butain WL, Lynn HB; Splenorrhaphy, changing concepts for traumatized spleen: Surg 86: 148 1979
5. Carlton CE: Jr. Injuries of the kidney and ureter. In Harrison, JH et at (Eds) Campbell’s urology. Vol.1 4th Edition, 1978.
6. Flint LM, McCoy M, Richardson JD, et al: Duodenal injury: Analysis of common mis conceptions in diagnosis and treatment Ann Surg 191(6): 697-702, 1980.
7. Feliciano DV: Patterns of injury, Mattox KL, Moore EE, Feliciano DV: Trauma, I edt. Norwalk, CT Appleton & Lange, 1988
8. Graham JM, Mattox KL, Jordon GL: Traumatic injuries of the pancreas. AM J Surg: 136(12): 744-748, 1978
9. Grieco J Perry J — Retroperitoneal hematoma following trauma J. Trauma 20:733, 1979

10. Heitsch RC, Knutson CO, Fulton RL, et al: Delineation of critical factors n the treatment of pancreatic trauma. Surgery 60(4): 523-529. 1976
11. Hoch WH, Dursh L, Persky L et al: Early aggressive management of intraoperative ureteral injuries J.Uro, 144:530, 1975
12. Hodges CV. Moore RJ, Lehman TH and Benham AM, Clinical experience with transureteroureterostomy. J. Uro 90:552, 1963
13. Hol croft JW, Trunkey DD et al: Renal trauma and retroperitoneal hematomas indication for exploration J trauma 15:1045 1975
14. Ivaturary RR, Nallathambi M, Gaudino J et al Penetrating duodenal injures Analysis of 100 consecutive cases, ann Surg 202(2): 153-158, 1985
15. Jones RC: Management of Pancreatic trauma: ann Surg 187(5) 555-564, 1978
16. Jeffrey RE, Federle Md, Craess RA Computed tomography of Pancreatic trauma, Radiology 147(5):491 -494, 1983
17. Jurkovich GJ, Surgical clinics of North America Vol 70 No:3 June 1990.
18. Kelly G, Norton L, Moore G et al: The continuing challenge of duodenal injuries trauma 18(3) 160-165, 1978
19. Kind H, Shumacker HB: splenic studies, ann surgery 136-239; 1952
20. Last RJ. Anatomy 8th Edition
21. Levison MA, Peterson SR, Sheldon GF et al: Duodenal trauma experience of a trauma center. J. trauma 24(6): 475-480, 1984

22. Lucas CE, Lederwood AM. Factors influencing outcome after blunt duodenal injury J.trauma 15(10) 839-846, 1975
23. Maingot.R. In Maingot's Abdominal operations 10th Edition
24. Moaninch JW, Carrol PR: Renal trauma, Kidney preservation through improved vascular control-A refined approach. J.trauma. 22:285, 1982
25. Moore EE, Shacford SR, Pachter HL, et al: organ injury scaling: spleen, liier and kidney j.trauma 29:1664, 1989
26. Moosa A.R., A Cuschiari, G.R. Giles Essential Surgical Practice, 2nd Edition
27. Ochsner JL, Crawford ES, Debakey ME: Injuries of the vena cava caused by external trauma. Surgery49:397-405, 1961
28. Pate) J, Williams JS, Shmigel B at a) preservation of splenic functions by auto transplantation of spleen in man, Surg 90:683, 1981.
29. Peters PC and Bright TO Ill: Blunt Renal Injuries Uro Clinic North America 4:17, 1977.
30. Philips. J. Huber. Colonic Injuries. SCNA Vol 70: No. 3 1990.
31. Peitzman AB, Makaroun Ms, Slasky 85 at al. Prospective study of computed tomography in initial management of Blunt abdominal trauma. J.trauma 26(7) 585-592, 1986.
32. Pisters PW, Pachter HL. Autologus Splenic transplantation for spenic trauma. Ann Surg2l9:225 1994.

33. Sagalowsky I. and Paul 0. Peters. Genito urinary Trauma. Campbell's urology
34. Snyder WH Ill et al: The Surgical Management of duodenal trauma, Arch Surg: 115:422-429. 1980.
35. Steichen FM, Dargan EL et al: The management of retroperitoneal hematoma secondary to penetrating injuries Surg gynecol obstet 123:581 1966.
36. Touloukiann R. Splenic preservation in children world J surg 9:214:1985
37. Traub A.Giebink GS Smith C. et al Splenic recticuloendothelial function after splenectomy, splenic repair and splenic auto transplantation. N Eng J med 317:1559, 1987
38. Weigelt AJ. Duodenal lnjuries.SCNAVoI.70 No: 31990